# California's Shrinking Defense Contractors

## *Effects on Small Suppliers*

RAND

Georges Vernez
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Kevin F. McCarthy
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*National Defense Research Institute*

The research described in this report was sponsored by the Office of the Secretary of Defense under RAND's National Defense Research Institute, a federally funded research and development center supported by the Office of the Secretary of Defense, the Joint Staff, and the defense agencies, Contract MDA903-90-C-0004.

ISBN: 0-8330-2355-1



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Cover Design: Peter Soriano

Published 1996 by RAND
1700 Main Street, P.O. Box 2138, Santa Monica, CA 90407-2138
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# PREFACE

This report is one of a series written as part of a project that investigates the effects of the defense draw-down on California's economy. This report investigates the effects of declining defense outlays on small suppliers to aerospace manufacturers. Others in the series examine the effects of military base closures in the state's communities and the effect of declining defense budgets on workers in the aerospace industry.

The project was sponsored by the Office of the Undersecretary of Defense (Personnel and Readiness). It was carried out in the Forces and Resources Policy Center of the National Defense Research Institute, a federally funded research and development center sponsored by the Office of the Secretary of Defense, the Joint Staff, and the defense agencies.

This report and its companion pieces (listed below) should interest anyone involved in the interactions between the Department of Defense, its contractors and suppliers, and civilian communities.

Michael Dardia, Kevin F. McCarthy, Jesse Malkin, and Georges Vernez, *The Effects of Military Base Closures on Local Communities: A Short-Term Perspective*, Santa Monica, Calif.: RAND, MR-667-OSD, 1996.

Robert F. Schoeni, Michael Dardia, Kevin F. McCarthy, and Georges Vernez, *Life After Cutbacks: Tracking California's Aerospace Workers*, Santa Monica, Calif.: RAND, MR-688-OSD, 1996.

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# SUMMARY

## THE PROBLEM

This study investigated how small, California-based suppliers in the defense aerospace industry weathered the Pentagon's budget downturns of the early 1990s.

Aerospace companies have reeled in the wake of a 20-percent drop in the amount that the Pentagon budgeted for research and development and for procurement between 1989 and 1994. Nationwide, the U.S. aerospace industry job base has shrunk by 25 percent.

The impact has been even more dramatic in California. Home to one in four of the country's aerospace employees in 1989, California has seen its aerospace industry employment rolls fall by 40 percent. Much of the decline has been in Los Angeles county, where 10 percent of the nation's aerospace employees worked in 1989. In 1994, some 121,000 people worked in the aerospace industry in the county, half the number employed in that sector five years earlier.

Small suppliers (those with 500 or fewer employees) may be particularly sensitive to Pentagon budget cuts. Unlike large defense contractors with broad mixes of products and manufacturing procedures, small suppliers typically concentrate on making one or a handful of products. They account for the bulk of firms in the aerospace business even though they receive only 10 percent of defense dollars going to contractors. Nevertheless, they make up a crucial segment of the aerospace industry, one that would be difficult

to replace should defense cuts force many of them out of military contracting.

This study investigated how small suppliers were impacted by defense procurement cuts, how they responded to the cuts, and how effective government programs were in blunting the cuts' impacts. The study traced the experience that small suppliers have had with producing for both defense and commercial customers. Additionally, the study investigated how defense downsizing may influence the ability of small aerospace suppliers to make crucial defense products in the future.

## HOW WE STUDIED THE PROBLEM

We used case studies of 25 small defense aerospace suppliers in southern California, chosen from a list of firms that supplied products to three of the largest military aircraft programs in the 1988–1990 period. Typical of small suppliers, these firms' median employment was 68 workers. Case studies allowed us to conduct in-depth interviews with executives to obtain information on their responses to defense downsizing.

## WHAT WE FOUND OUT ABOUT IT

All case study firms felt the impact of defense spending declines, although not necessarily in the same proportions. To date, most suppliers have survived the reductions by shaving their work forces, increasing their productivity, or expanding into commercial markets, or by some combination of those tactics.

For the case study firms, annual defense revenues fell by an average of 43 percent between 1990 and 1994. However, total revenues did not fall so dramatically, declining on average only 15 percent. Employment declined proportionately.

Firms had varied success in compensating for lost defense revenues, depending on their product lines. The 11 electronics firms and materials firms we studied were generally more successful in expanding their commercial revenue basis. A majority increased total revenues significantly, mostly from sales to nonaerospace commercial customers. These firms already had a foothold in the commercial non-

aerospace market prior to 1990 and were facing a growing market for the type of products they manufacture.

In contrast, the 14 machine shops and aircraft parts firms we studied were less successful in finding additional commercial revenues, replacing only one of five lost defense revenue dollars. New revenues came mostly from additional sales to commercial aerospace customers. These firms' manufacturing processes were designed for narrow tolerances and low volumes and have not been readily transferable to high-volume/cost-competitive nonaerospace commercial applications. In addition, these firms have lacked the knowledge and marketing experience to enter nonaerospace markets. As a result, few have been able to make the transition; most abandoned the effort, perceiving it as simply not feasible.

In producing for commercial markets, firms used the same production lines and processes that they used in defense manufacturing. They did not physically segregate any parts of their operations or set up a separate data management system to do business with prime contractors.

Although most firms downsized or otherwise changed to accommodate the new business environment, most did so in ways that did not weaken their capabilities. Most firms with an engineering staff generally protected that staff. They also cut costs and increased productivity. Most case study firms indicated they could increase production to previous peak levels within four to six months, should the need arise. And most indicated they had no plans to move away from California, which offers access to customers and suppliers and to a skilled labor force.

Only one firm took advantage of available federal defense conversion programs, including the Defense Technology Reinvestment Projects. By and large, the focus and structure of federal programs are not designed for the needs and capabilities of small supplying firms. The general perception among the case study firms was that any benefits were outweighed by the costs of application and of meeting the stringent program requirements. In contrast, 25 percent of the firms received funds from California to train or retrain their workers.

Our study of 25 firms drew three conclusions that require further research on a larger representative sample of small suppliers:

# ACKNOWLEDGMENTS

We are indebted to the many respondents of defense aerospace supplying firms who shared their time and insight so generously. Dr. Curt Gilroy, director, and Dr. John Enns, of the Office of Special Projects and Research at the Department of Defense, oversaw the conduct of the study.

The study was conducted by several researchers and truly represents an interdisciplinary team effort. Michael Dardia had the idea for conducting the study in the first place. He designed the study with Kevin McCarthy and Georges Vernez. Jesse Malkin coordinated the field work, in which all team members participated. Finally, Georges Vernez was responsible for the analysis and the writing of this report. He received substantive input and comments from Kevin McCarthy and other members of the team.

Our RAND colleagues Susan Hosek and Robert Schoeni provided support and encouragement. Gordon Lee assisted in the organization and presentation of the material in this report. This report also benefited from the thoughtful reviews of Richard Buddin and Carl Dahlman. Although their suggestions for interpreting and presenting material were particularly useful, they are in no way responsible for the report's conclusions or shortcomings.

Finally, we appreciate the excellent secretarial and administrative assistance provided by Karla McAffee.

- Machine shops and aircraft parts suppliers remain almost entirely dependent on the aerospace industry. Further reductions in demand for military or civilian aerospace products may push many of them out of business.
- Small defense aerospace suppliers are not making cutting-edge products for commercial customers.
- Small defense aerospace suppliers in southern California may suffer from increasing shortages of two types of skilled employees: (1) engineers with experience in programming software for electronic warfare systems and for product design and testing and (2) experienced machinists with problem-solving skills.

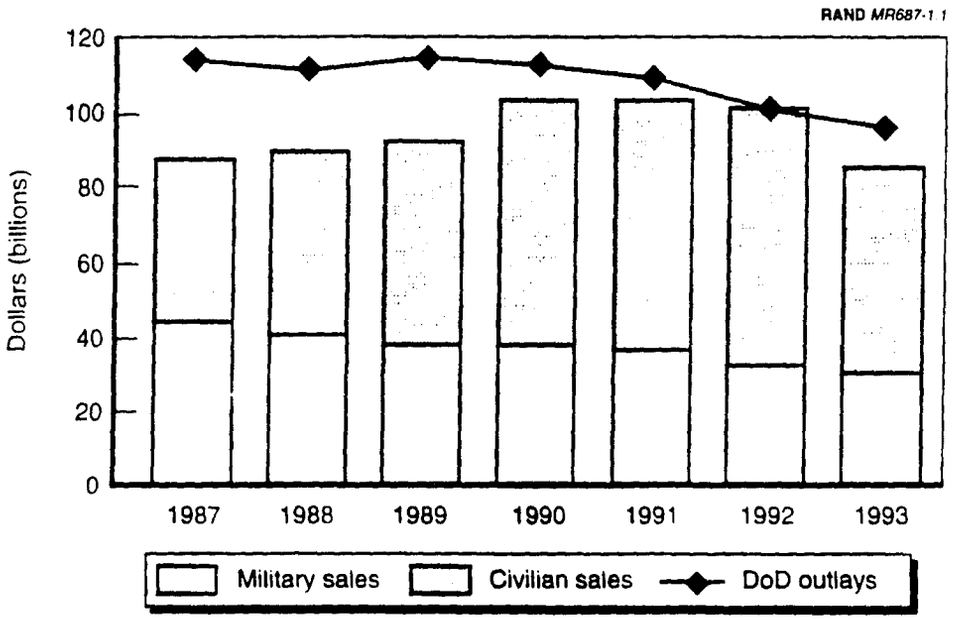
Chapter One

# INTRODUCTION

This study investigated how small, California-based suppliers in the defense aerospace industry weathered the Pentagon's budget downturns of the early 1990s. To date, most of these suppliers have survived the reductions by shaving their work forces, increasing their productivity, or expanding into commercial markets, or by some combination of those tactics.

## BACKGROUND

The end of the Cold War has brought profound changes to the U.S. military and to sectors of the civilian economy that have been linked closely to the armed services. The new political and economic environment of the 1990s is defined by leaner Pentagon budgets, fewer uniformed personnel, and growing closure lists of bases, shipyards, and other facilities that maintain or manufacture military equipment. Figure 1.1 tracks changes in military and civilian aerospace sales in light of the drop in Department of Defense outlays for procurement and for research and development in the late 1980s and early 1990s. Defense budget authority crested in 1985 at $376 billion. But procurement and research and development outlays continued to increase through 1987, flattened in 1989, and declined from 1990 to 1994. By 1994, outlays had declined by 26 percent.




SOURCE: Budget of the United States and Aerospace Facts and Figures 1994–1995.

**Figure 1.1—Defense Department Outlays and Aerospace Industry Sales, 1987–1993**

The aerospace industry has been at the center of these contractions. Military aerospace sales topped out in 1987 and by 1993 had declined by some 32 percent. However, because increased sales to civilian airline, freight, and missile customers more than compensated for this decline in military revenues, total aerospace sales rose for several years after military sales dipped. Total aerospace sales peaked in 1990 and by 1993 had dropped by 17 percent.[1]

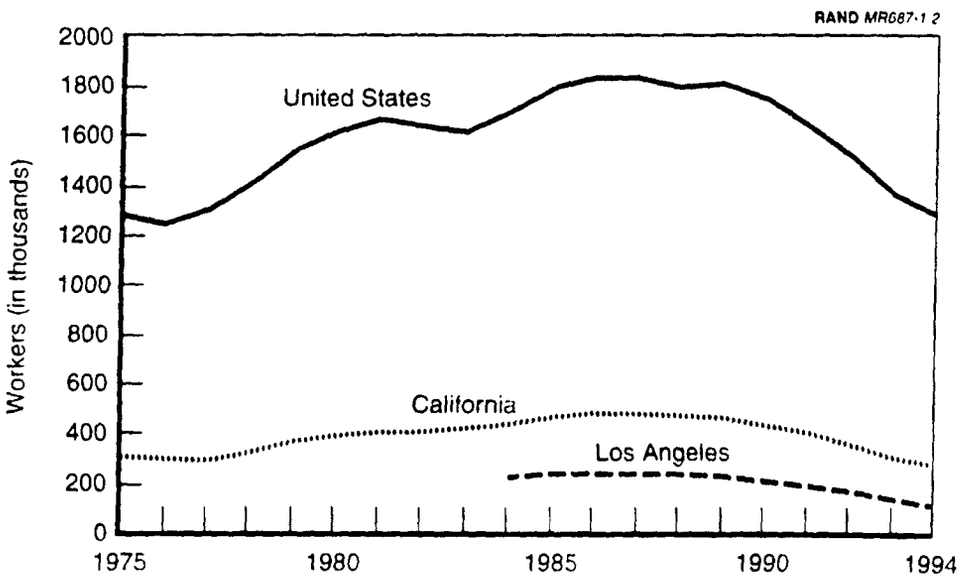
As the Pentagon has become smaller over the past eight years, its need for sophisticated aerospace products has dropped. And for some companies heavily dependent on defense business, minor changes in the Pentagon's budget outlays translate into major dislocations on the factory floor. Nationwide, the aerospace industry's job base has shrunk by 25 percent since 1989.

[1] Data are not yet available for later years.

Nowhere have those changes been more apparent than in California and the Los Angeles basin. The state in 1987 was home to one in four U.S. aerospace jobs. In Los Angeles county alone, aerospace jobs accounted for 10 percent of the national total.

Since then, the aerospace industry in California—which accounts for over two-thirds of all defense employment in California—has become a shadow of its former self. The state's employment in aerospace rolls has fallen 40 percent compared with 1989, while in Los Angeles county the industry's job base slid to 121,000 in 1994 from 232,000 in 1989, nearly a 50-percent drop (see Figure 1.2).

To cushion the shock brought about by smaller defense budgets, the federal government has targeted numerous assistance programs at firms, workers, and communities. Some are geared toward dislocated workers or communities that traditionally have been heavily dependent on defense dollars. Other programs aim to help firms wean themselves from defense dependence by better integrating their defense and commercial production. All the programs seek to preserve the aerospace industry's ability to produce vital weapons




NOTE: 1994 is for the third quarter.

**Figure 1.2—Aerospace Employment in California and the United States, 1975–1994**

systems. Congress has authorized increasing appropriations (in excess of $3 billion in 1995) to these conversion programs (Defense Conversion, Reinvestment, and Transition Amendments of 1994).

## FOCUS OF STUDY

This study examined small companies based in California that supply goods and services to prime defense aerospace contractors. Few studies have concentrated on how these firms, which make up the bulk of the companies in the aerospace business, have endured the defense budget downturn.[2]

The defense industrial base consists of an intricate network of large and small firms spanning a variety of different industries, all of which contribute in some fashion to the production of weapons systems. Firms within that network range from those that produce or process the raw materials up to those that design, coordinate, and assemble the final weapons system. At the risk of oversimplification, that industrial base consists of three separate tiers, each successively removed from the final product:

- **Prime Contractors:** This group consists of a few large defense contractors who are responsible for overall design (system integration) of the weapons system, management of production, and

[2]Other studies have focused on how large and medium aerospace contractors have withstood the defense downturn, not on small suppliers with 500 or fewer employees. A survey by Logistics Management Institute looked at the effects of procurement declines on a set of large subcontractors, drawn from government data sources (Gentsch and Peterson, 1993). They identified just over 200 plants for 11 weapons programs. In contrast, Dardia (1995) identifies in excess of 3,000 supplier plants for just three aircraft programs. A survey conducted by the Center for Strategic and International Studies focused on the integration of military and commercial production (van Opstal, 1993). The CSIS survey covered 206 firms; it is not clear how large the population was or what the response rate was. The sample was also somewhat biased toward large firms: 27 of the respondents had sales under $50 million and thus could be considered small firms. The most comprehensive survey covered firms in 21 durable-goods industries considered to be "machining intensive"; it received responses from 973 plants and had an 84-percent response rate (Kelley and Watkins, 1995). It too focused on the degree of separation between defense and commercial production, as well as differences between competitive and technology environments in the two areas. Flaming and Drayse (1994) surveyed aerospace firms in southern California and found that defense dependency increased with firm size; this conflicts with the findings of Kelley and Watkins.

final assembly. They account for about half of all defense procurement dollars. Workers at these firms are typically the most skilled and highest paid in this sector.

- **Large Subcontractors:** This group is made up of a slightly larger number of firms or corporate divisions, which are responsible for designing and producing one or more major aircraft components—radar systems, fuselage, landing gear, or related component systems. These firms tend to be large, with highly skilled employees. Often a prime contractor in one program may serve as a major subcontractor for another program. In general, the major subcontractors receive about 40 percent of total procurement dollars and represent a similar percentage of total employment.
- **Suppliers:** This group consists of a large number of small, diverse firms or divisions of larger companies, which supply a particular part, subsystem, or related element of the product. Often these firms specialize in a specific element or fill a special niche in the production process, making particular parts, e.g., hinges, power systems, machine parts, or tools. They vary in size from several thousand employees to as few as a half dozen, but most employ less than 100 people. These firms constitute the bulk of all firms on a particular program but receive only about 10 percent of the defense contractor dollars. They make an array of products, employ workers at all skill levels, and are engaged in a variety of manufacturing operations. Some make parts specially designed for defense use that have no application in the commercial sector.

Although small firms receive only 10 percent of defense contractor dollars, they nevertheless make up a crucial segment of the aerospace industry. They make specialized, often sophisticated, parts, testing instruments, and machine tools that are key to the success of any defense procurement program, and they would be difficult to replace if many of them were to exit the defense industry as a result of Pentagon cuts. Moreover, many small firms are in California, especially southern California, and their demise could mean that the area no longer would have as strong a hold on larger prime contractors, who are located there in part to be close to a rich network of specialized suppliers and skilled labor.

## KEY QUESTIONS

This study examined how small aerospace suppliers were impacted by cuts in defense procurement, how they responded to those cuts, and how effective were government programs in helping them adjust to a changing business climate. Specifically, the study asked the following questions:

- How has defense downsizing affected revenues and employment of small aerospace suppliers in California?
- How have smaller defense outlays changed the relationship between defense prime aerospace contractors and their small suppliers?
- What strategies have small aerospace suppliers used to cope with defense downsizing?
- What experience have small aerospace suppliers had with producing for both defense and commercial customers, and what barriers have they encountered when they sought to move into commercial markets?
- To what extent have government programs been used in the transition that small aerospace suppliers have made? Have these programs helped? What changes might improve the effectiveness of these programs?
- How has defense downsizing impacted small aerospace suppliers' future capacities to make products needed for national defense?

## CASE STUDY APPROACH

We addressed these questions using a case study approach. We studied 25 small defense aerospace industry suppliers in southern California. We chose these firms from a list of California companies that had supplied goods or services to three of the largest military aircraft programs from 1988 through 1990, a list provided to us by the

programs' prime contractors.[3] We chose the case study approach because it allowed for face-to-face personal interviews that were conducive to giving us an in-depth understanding of the firms' decision processes and the steps they took to respond to defense downsizing. It also allowed us to visit production plants, helping to enhance our understanding of the firms' manufacturing and quality control processes.

The strength of the case study approach is its ability to provide detailed information on firm behavior and internal production processes. Its main limitation is the small number of observations, which constrained our ability to generalize to the whole universe of small California firms supplying parts and services to the defense aerospace industry.

## ORGANIZATION OF THIS REPORT

Chapter Two discusses our methodology and the characteristics of the firms we studied. It also outlines the study's limitations.

Chapter Three explores the effects of defense downsizing on the firms' total and defense-related revenues and employment. The chapter examines the firms' relationships with prime contractors. It also discusses the firms' relative success with expanding or diversifying into commercial markets.

Chapter Four outlines the various strategies, and their components, that the firms have used to cope with defense downsizing.

In Chapter Five, we discuss the firms' experience with dual-use production and prospects for further expansion in this area.

Chapter Six investigates how effective were governmental defense conversion and other programs in helping small and medium-sized aerospace industry suppliers cope with reduced Pentagon outlays.

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[3]For a full description of the list see Dardia (1995). We use the term "firms" in this report to include companies and other corporate enterprises supplying goods and services to prime defense contractors.

Finally, in Chapter Seven, we discuss our respondents' expectations for their firms. We also assess the health of defense aerospace suppliers based in southern California.

Chapter Eight summarizes the main findings.

An appendix presents the form that was used to record the information gathered in the interviews of defense suppliers.

Chapter Two

# METHODS AND LIMITATIONS

This chapter outlines how we selected the 25 firms for the case studies, describes their characteristics, and introduces the protocol used in interviews with the firms' executives. The chapter concludes with a discussion of the study limitations.

## SELECTION OF CASE STUDY FIRMS

The 25 case study firms were selected, in two steps, from a list of 1,095 California firms that had supplied parts and services to three of the largest military aircraft programs from 1988 through 1990.[1] First, we identified a subset of 485 firms[2] that aerospace executives and the literature (Tyson et al., 1989) indicated are critical to the defense aerospace industry either because they are highly dependent on defense and commercial aerospace work (and hence especially vulnerable) and/or they provide highly specialized defense-specific technological skills. These firms fall into four main categories:

- Machine shops and machine tools (SIC 3544, 3599). They make high-precision parts, tools, dies, and/or prototypes in low volumes.

[1] California was the home of more than one-third of the 3,200 supplying firms to the three aircraft programs nationwide.

[2] An additional 37 firms meeting our criteria were no longer in existence under the same name and at the same location in 1992.

- Aircraft parts makers (SIC 3721, 3724, 3728). They manufacture high-precision parts for airplanes and other products typically in moderate to high volumes.
- Electronics firms (SIC 3625, 3663, 3672, 3674-3679 and 3812, 23, 25, 29, 61). They make electronic components for a wide variety of applications.
- Materials firms (SIC 3089, 3463). They forge metal or make composites, usually in high volumes.

From this subset of firms we randomly selected 60 firms with 500 employees or less in 1990, 25 of which were actually interviewed.[3] Table 2.1 compares the case study firms to the universe of firms from which they were selected on the dimensions of type and number of employees.

## CHARACTERISTICS OF SAMPLED FIRMS

The characteristics of the 25 case study firms are summarized in Table 2.2. The firms' names have been omitted to protect confidentiality. Six of the firms are machine tools and machine shops, eight

**Table 2.1**

**Characteristics of "Universe" and Case Study Firms**

| | Firms in Universe | | Case Study Firms | |
|---|---|---|---|---|
| Type of Firms | Number | Median Number of Employees 1990 | Number | Median Number of Employees 1990 |
| Machine shops/tools | 162 | 22 | 6 | 23 |
| Aircraft parts | 96 | 81 | 8 | 86 |
| Electronics | 187 | 90 | 8 | 79 |
| Materials | 40 | 49 | 3 | 38 |
| Total | 485 | 48 | 25 | 68 |

SOURCE: Dun and Bradstreet Information Services (1995).

[3]Of the remaining 35, 27 were unable to schedule an interview within the two-month time period allocated to this portion of the study or did not return calls, seven declined to be interviewed, and one could not be identified.

**Table 2.2**

**Characteristics of Case Studies Purposive Sample by Primary Classification**

| Classification (number of firms) | Number of Employees in 1994 | | Average Age of Firm | Location | Number of Firms with Following Characteristics: Initial Market | Corporate Status | Number of Prime Contractors | Markets Served Today | Product Lines |
|---|---|---|---|---|---|---|---|---|---|
| Machine shops (6) | Mean:<br>Low:<br>High: | 26<br>6<br>45 | 33 | 6 LA Co. | 4 Defense<br>2 Both | 6 Independent | 3 Few<br>3 Many | 5 Aerospace<br>1 Dual | Machine parts, tools, and/or airplane parts |
| Aircraft Parts (8) | Mean:<br>Low:<br>High: | 118<br>7<br>285 | 31 | 7 LA Co.<br>1 Orange Co. | 2 Defense<br>3 Commercial<br>3 Both | 7 Independent<br>1 Corporate | 1 Few<br>7 Many | 7 Aerospace<br>1 Dual | Fuel pumps, hinges, screws, fasteners, valves, sheet metal parts, rings, wires, cables |
| Electronics (8) | Mean:<br>Low:<br>High: | 136<br>10<br>390 | 28 | 4 LA Co.<br>2 Orange Co.<br>1 San Diego Co.<br>1 Ventura Co. | 6 Defense<br>2 Both | 5 Independent<br>3 Corporate | 8 Many | 1 Aerospace<br>7 Dual | Conductors, transformers, generators, receivers, miniature memory modules, electromechanical switches, transducers, electronics, power converters, photographic |
| Materials (3) | Mean:<br>Low:<br>High: | NA<br>38<br>500 | 23 | 2 Orange Co.<br>1 Ventura Co. | 1 Defense<br>1 Commercial<br>1 Both | 2 Independent<br>1 Corporate | 3 Many | 1 Aerospace<br>2 Dual | Forging, composites |

produce aircraft parts, seven manufacture primarily electronics products, three are providers of manufactured materials. All firms are located in southern California, with most located in Los Angeles county. All firms are well established, having been in business an average of 29 years. The oldest firm was established 45 years ago and the youngest 11 years ago. Machine shops and makers of aircraft parts are only slightly older than electronics firms. Half of the firms were established to serve the defense market, eight were established to serve both defense and commercial markets, and four started by serving the commercial markets and made a relatively rapid transition into serving the defense market as well. With a few exceptions, the firms are independent and have all of their operations centralized at one location. The five exceptions are firms that are divisions of broader corporations (three) or owned by a parent company (two).

The case study firms vary in size from extremely small (six employees) to medium size (500 employees). Machine shops tend to be small, averaging 26 employees. Aircraft parts suppliers and electronics firms in our sample average 118 and 136 employees, respectively. There are broad variations within each type of firm, ranging from very small to medium size.

With the exception of a few machine shops, all firms serve most, if not all, of the defense prime contractors. None of the firms in our sample serves the defense market exclusively. The majority (14), mostly machine shops and aircraft parts firms, serve only aerospace customers (both defense and commercial). The remaining 11 firms, mostly electronics and materials firms, produce products for both the aerospace and nonaerospace commercial markets. As we shall document later in this report, these distinctions in market orientation are critical in understanding the opportunities firms have had and the strategies they have used to cope with the drop in demand in the defense sector.

## FIRM INTERVIEWS

We conducted interviews with the owner, the CEO, a vice president, or the general manager of each of the 25 firms. In larger firms the owner or CEO was often accompanied in the interview by a vice-president for marketing, operations, or finance. In addition to ques-

tions about the history of the firm and its product line, respondents were asked to

- describe changes in level of activities and employment since 1990, including changes in share of revenues generated by defense sales and the composition of employment
- describe how they cut their work force, any assistance provided to laid-off workers, problems with hiring or management of a diverse labor force, and training by the firm
- describe the various ways operations were directly affected by the defense downsizing, including changes in location or facilities, loss of best employees, sale of equipment
- describe and assess the active measures taken to minimize the effects of defense downsizing on the firm, including seeking preferred-supplier status and making changes in outsourcing practices, operations (such as machining, handling of inventory, quality control, assembly, and finishing), and development of new products for either the defense or commercial market
- assess their experience with dual-use products or with producing defense and commercial goods with the same employees and equipment
- describe their use of government programs designed to facilitate adjustments induced by defense downsizing and assess the effectiveness of these programs
- describe their plans and expectations for the future (including plans to expand, relocate, or reduce defense production) and assess their ability to resume defense production rapidly should the circumstances require it.

The protocol used to guide the interviews is reproduced in the Appendix. The interviews were conducted on-site and lasted up to two hours. In most cases, the interview was preceded or followed by a tour of the plant. The interview data were analyzed in two ways. A firm summary was prepared immediately following the interview with each firm. These summaries were prepared using a common outline and could be easily compared. In addition, a comparative summary of all key data elements was prepared by topical area as

outlined above to further identify commonalities as well as differences in firms' behavior.

## LIMITATIONS OF THE STUDY

This study of the responses to defense downsizing of firms supplying services and products to defense prime contractors has several limitations.

First, our findings are based on a small number of firms, all located in southern California. Although we took care to have representation of various types and sizes of firms and of products, our case study firms are not necessarily representative of all supplying firms in and outside of southern California. In addition, the firms in this study were selected as a result of their participation in three major military aircraft programs, and our findings reflect the responses of firms supplying the aerospace industry exclusively. They do not necessarily represent firms that provide parts for other large military programs, such as submarines, tanks, and artillery.

Second, our study covers the limited time period—1990 to spring 1995—that followed the major decline in defense procurement outlays and aerospace employment, both of which began in 1989 (see Chapter One). We have no knowledge of changes in conditions that may have taken place before then and how they may have affected the firms. Several respondents indicated that they had suffered cutbacks in earlier periods from various sources, including cuts in the oil drilling industry and in demand for commercial aircraft in the early to mid-1980s, but none indicated that they had begun downsizing their own operations prior to 1990.

Finally, all the information upon which we base our results is drawn from self-reports by executives of the firms in our sample. Self-reports are subject to unknown bias, especially information about changes in revenues and employment that date back four years or so. To an unknown extent, these self-reports may differ from what actually happened. However, we did look for contradictions in reported figures and made consistency checks in responses by executives from each specific firm. The plant visits also offered an opportunity to check what we were told against what we actually saw. We found few inconsistencies.

Chapter Three

# EFFECTS OF DEFENSE DOWNSIZING ON FIRMS

Firms providing services and products to defense contractors or the DoD have faced two important byproducts of the decline in defense spending: (1) a decline in demand for their products and (2) an increase in the requirements they must meet in order to do business with defense prime contractors. This chapter first examines the effects of the decline in aggregate demand on firms' employment, total revenues, and the defense share of that total. Where there were cuts in a firm's labor force, we examine the nature of those cuts and the extent to which workers were assisted in their transition to other employment. Changes in the contractual relations between the defense prime contractors and their suppliers, along with the effects of these changes, are discussed last.

## REVENUE AND EMPLOYMENT EFFECTS

Drops in aggregate demand, such as those stemming from rapid declines in defense spending, can have one or a combination of effects on prime contractors and, eventually, defense suppliers as a whole. To protect their own companies and employees, prime contractors might reduce the proportion of work they contract out to suppliers, i.e., increase their vertical product integration. In this event, the defense downsizing would affect defense suppliers disproportionately. Although we have no direct evidence of the extent to which primes have exercised this option, several of our respondents indicated that prime contractors were actually eliminating or reducing operations (e.g., machine shops) that had competed with those of the respondents, or that they were increasingly contracting

for fully assembled components rather than parts which the primes would themselves assemble. Dardia (1995), using data provided in interviews with six of the ten top defense contractors, also found evidence that prime contractors have increased their use of subcontracting. In addition, he finds that value-added to sales in the aerospace sector declined from 61 to 55 percent between 1987 and 1991, suggesting that the proportion of materials purchased by primes has increased.[1]

Prime contractors may redirect their reduced demands for services and products (a) to fewer suppliers or (b) proportionately across all suppliers. In the first instance, the effect of downsizing is felt more strongly by some firms, and others may not only remain unaffected but may even see business with prime contractors increase. In the second instance, declines in defense spending are distributed across all suppliers, although not necessarily in the same proportions. The evidence presented below suggests that the second approach has been predominant to date, at least as far as supplying firms that are considered critical to their primes' supplier base are concerned.

## Most Firms Are Still in Business

When we checked with a random sample of small defense suppliers in 1992, all were still in operation.[2] There is no evidence that, prior to 1992, there was an unusual increase in failure rates in manufacturing in general or in industries closely related to the defense industry, such as fabricated metal products, machinery, electric and electronic equipment, and transportation equipment (see Table 3.1). The pattern of business failure is consistent across all these industries: their

[1] Dardia (1995) also notes that the trend of decreasing value-added as a fraction of sales is also present in other industries, such as motor vehicles, shipbuilding, and electronic components.

[2] This analysis is based on a random sample of 372 firms from the 485 firms in our original list. We located 1995 Dun and Bradstreet records for all but five firms.

**Table 3.1**

**Business Failure Rates by Industry, 1985–1993**

| Industry | Rate per 10,000 Firms | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1985 | 1987 | 1989 | 1990 | 1991 | 1992 | 1993 |
| Manufacturing | 109 | 95 | 79 | 91 | 128 | 129 | 109 |
| Fabricated metal | 125 | 111 | 87 | 90 | 135 | 145 | 128 |
| Machinery | 110 | 91 | 67 | 84 | 105 | 145 | 128 |
| Electric and electronic equipment | 154 | 113 | 117 | 114 | 149 | 157 | 122 |
| Transportation equipment | 165 | 131 | 117 | 146 | 198 | 158 | 140 |
| Instruments and related equipment | 85 | 78 | 66 | 68 | 106 | 92 | 81 |

SOURCE: U.S. Bureau of the Census (1992, 1994).

failure rates declined from 1985 to 1989, increased during the 1990–1992 recessionary years and declined once again thereafter.[3]

However, because the decline in demand for aerospace defense supplying firms continued after 1992 and may have forced many out of business altogether, we identified (using Dun and Bradstreet data) which of the firms in our original list were still operating in 1995, had merged or acquired, or had gone out of business.

Nearly all firms (94 percent) were still in business in 1995 under the same name and in the same location as in 1992, and 3 percent either had merged or had been acquired. The failure rate of firms was 3 percent, with only light variations in the probability of survival by type of firm: 2.7 percent for machine shops and electronics firms and 3.6 percent for aircraft parts and material firms.

Based on our interviews and our review of the relevant literature, we expected a higher attrition rate, particularly among machine shops, which our interviewees singled out as being especially hard hit by defense downsizing. Also Velocci (1994) reported that prime contractors, such as Douglas Aircraft, Lockheed Corporation, and Northrop, had cut the number of suppliers with whom they were doing business by more than 50 percent by 1994. Similarly, Dardia (1995) reports that the number of active suppliers to three large military

[3]Kelley and Watkins (1995) also found no evidence of a decline in the share of the overall manufacturing base (in the machining-intensive durable goods industries) between 1988 and 1991.

aircraft programs declined by 25 percent between 1990 and 1993. Finally, the low annual failure rate observed among the suppliers in our original list (.6 percent annually) is lower than the business failure rate for manufacturing as a whole and for such industries as transportation equipment or electric and electronic equipment (Table 3.1).

The low rates of failure of aerospace supplying firms may be due to three factors. The first is that defense aerospace firms are well-established firms—the average age of our case study firms is 29 years—hence, they are long-term survivors that have gone through sharp downward fluctuations in demand for their products several times before. A second reason may be the high barriers—including track record, capital equipment, and "good will of the prime"—for entry into the defense supplying business which were noted by several of our respondents. Finally, the suppliers dropped by the primes are likely to be the least dependent on defense contracts for their revenues; loss of defense revenues may require some downsizing, but it is unlikely to cause their going out of business altogether. Indeed, Kelley and Watkins (1995) showed that the median defense share in total sales in 1990 for plants with any defense subcontracts was only 15 percent.

As of 1995, the continuing availability of a broad range of suppliers capable of providing specialized services and products for military aerospace had not been seriously eroded in California.

## Overall Effects

Although few aerospace supplier firms have been forced out of business, they have nevertheless been significantly affected by defense downsizing. Detailed data on revenues and employment changes for all firms in our original list were not available, but were provided by the 25 case study firms. Although we cannot generalize, the pattern of changes in revenues and employment in these firms may be generally indicative of changes for suppliers upon which military aerospace is heavily dependent.

In the aggregate, annual defense revenues[4] for the case study firms dropped 43 percent between 1990 and 1994, compared with a 15-percent drop in revenues from all sources (Figure 3.1). A significant shift away from defense to commercial revenues took place during this period, as the proportion of defense revenues in total revenues declined from 59 percent in 1990 to 39 percent in 1994. Although lower, the overall dependency of these firms on defense contracts remained high.

Total net employment reductions in case study firms were roughly proportional to reductions in real revenues from all sources, 18 percent vs. 15 percent.

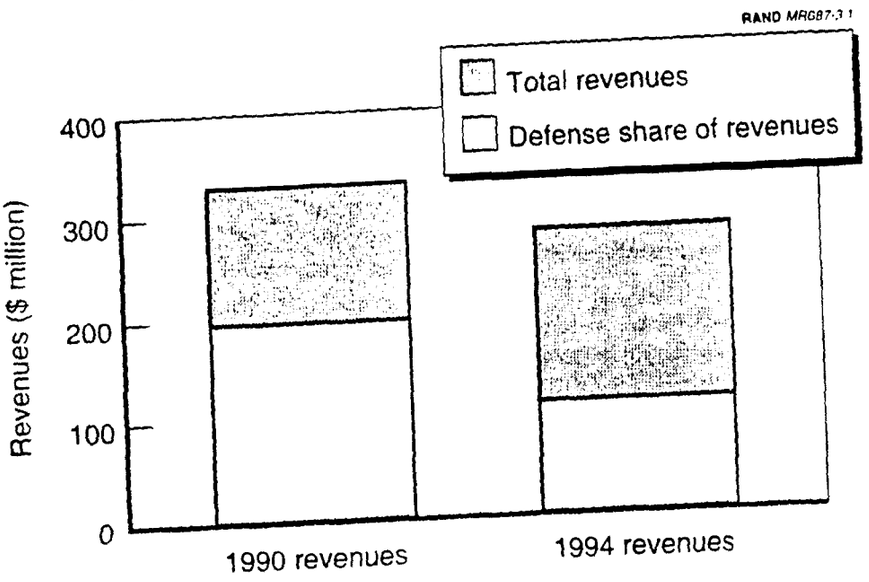


**Figure 3.1—Total and Defense Revenues in Case Study Firms, 1990 and 1994**

[4]All revenues—defense and total—discussed in this chapter are expressed in constant 1994 dollars.

## Variations Among Firms

Although all firms experienced a reduction in defense revenues, these reductions varied significantly by type and within type of firm. Also, firms had varying success in recouping partially or fully lost defense revenues (Table 3.2).

All but three firms in our sample saw their defense revenues decline significantly after 1990. Machine shops were most affected—losing more than 60 percent of their defense related revenues—and aircraft parts firms were least affected—losing 34 percent of their defense revenues between 1990 and 1994.

As a group, electronics and materials firms were more successful than machine shops and aircraft parts firms in compensating for reduced defense revenues with increased revenues from other sources, including aerospace and other commercial markets. Indeed, six of the 11 electronics and material firms in our sample not only compensated for lost defense revenues, but increased their revenues from other sources so that their total annual revenues grew by an average 66 percent between 1990 and 1994. Simultaneously, their share of defense in total revenues declined from two-thirds to less than half. The road to recovery and eventual growth in total revenues was not necessarily continuous. Several of these firms did experience sharp declines in revenues during the period and laid off workers, only to have to hire new workers a year or two later.

**Table 3.2**

**1990–1994 Percentage Changes in Annual Revenues, Share of Defense Revenues, and Employment by Type of Industry**

| | Revenues | | Share of Defense in | |
|---|---|---|---|---|
| Type of Industry (n) | Defense | Total | Total Revenues | Employment |
| Machine shops (6) | −63 | −51 | −23 | −43 |
| Aircraft (8) | −34 | −27 | −11 | −30 |
| Electronics (8) | −40 | −19 | −25 | −18 |
| Materials (3) | −39 | +24 | −68 | +33 |
| Total | −43 | −15 | −34 | −18 |

NOTE: Thirteen out of the 14 machine shops and aircraft firms experienced a net decline in total revenues. In contrast, seven of the 11 electronics and materials firms experienced a net increase in total revenues.

Machine shops and aircraft firms were not as successful in expanding revenues from sources other than defense. As a group they were able to increase revenues from other sources to replace about 20 percent of the defense revenues they lost. All but one of the 13 firms in our sample experienced a net decline in revenues from all sources between 1990 and 1994. The one aircraft firm that increased its revenues by 127 percent did so by increasing its defense and other revenues in equal proportions.

Changes in employment generally matched changes in revenues.

## Reasons for Differences Among Firms

No single set of factors, internal or external to a firm, accounts for the wide disparities in growth patterns across the case study firms (also see Chapter Four). Still, two factors appear to have played a major role in separating firms that were more successful from those less successful in weathering and compensating for defense downsizing.

The first, an internal factor, is whether the firm already had some experience making products for commercial markets other than aerospace. Six of the seven firms with real increase in total revenues in our sample already were making products for both markets in 1990. By contrast, 80 percent of firms with declining total revenues were serving the aerospace industry exclusively, albeit both defense and commercial aerospace (Table 3.3).

**Table 3.3**

**Selected Characteristics of Declining and Growing Firms: 1990–1994**

| | Number of Firms with Following Characteristics | | | Number of Firms in Each Size Category | | | |
|---|---|---|---|---|---|---|---|
| Direction of Revenue Growth | Markets Served (number of firms) | Classification (number of firms) | Mean Number of Employees | 0–50 | 50–100 | 100–200 | 200+ |
| Declining | Dual (3) | Machine shops (6) | 1990: 130 | 7 | 3 | 4 | 3 |
| | Aerospace (14) | Aircraft parts (7) | 1994: 87 | 10 | 3 | 1 | 3 |
| | | Electronics (3) | | | | | |
| | | Materials (1) | | | | | |
| Growing | Dual (7) | Aircraft parts (1) | 1990: 130 | 4 | 1 | 0 | 3 |
| | Aerospace (1) | Electronics (5) | 1994: 164 | 3 | 2 | 1 | 2 |
| | | Materials (2) | | | | | |

The second factor is whether there was a growing market—defense and/or commercial—for the kind of products produced by a firm. Hence, it is not surprising that four of the seven firms whose total revenues increased specialize in developing, producing, and/or assembling electronic products. Of the remaining growth firms, two are specialized material firms. By contrast, most of the declining firms are machine shops and aircraft parts firms making products relying on well-established technology. These firms typically found the transition from the high-precision, high-quality aerospace industry to the lower-precision, highly cost-competitive commercial market too difficult to bridge both in terms of know-how and cost structure. (Also see Chapters Four and Five.)

Size did not seem to play a major role in determining which firms were more successful in compensating for declining demand for defense products. There were no major differences between the average size and the distribution of firms by size between growing and declining firms in our sample at the outset of defense downsizing (see Table 3.3). Half of the growth firms had less than 50 employees in 1990 compared to 40 percent of declining firms. And the same percentage of growing and declining firms (38 percent) had 100 or more employees in 1990. In this size group, however, growth industries tended to be larger, all exceeding 200 employees.

## HOW FIRMS DECREASED THEIR LABOR FORCE

Between 1990 and early 1994, the firms with declining revenues in our sample laid off three times more workers than growing firms hired. Most firms, particularly the smaller ones, cut their labor force gradually, mostly through attrition and early retirement. Only in extreme cases did they resort to layoffs, often a few at a time. Seven of the larger firms (with 100 employees or more) resorted to layoffs either all at once or in discrete waves keyed to the termination of contracts with prime contractors or the federal government.

The bulk of the cuts in the labor force occurred among production workers, who in most cases constituted more than 50 percent of the work force. By and large, firms sought to cut more deeply among administrative staff—although not among quality assurance and/or testing staff—and sought to maintain a critical mass in their engineering staff. The latter represents a larger share of the labor force in

electronics and materials firms than in machine shops and aircraft parts firms (Figure 3.2). Electronics and materials firms that increased overall staffing generally increased their engineering staff proportionately while those who laid off staff generally cut engineering less than proportionately. Even in the latter case, the firm retained a critical mass of engineers. Only one small firm cut its engineering staff more than proportionately. Similarly, all but one aircraft parts firm with an engineering department kept its engineering staff intact.

Nearly all firms' managers stressed that the layoff process was painful for them as well as for the employees; it affected their labor force morale negatively. Several managers suggested they had held on to their workers longer than they should have. Some firms, especially the larger ones and those that were part of a larger organization, actually viewed the layoff process as a useful corrective tool, since it enabled them to weed out marginal workers. The language used to describe the whole layoff process seemed to differ greatly between smaller firms, who often spoke in paternalistic terms about

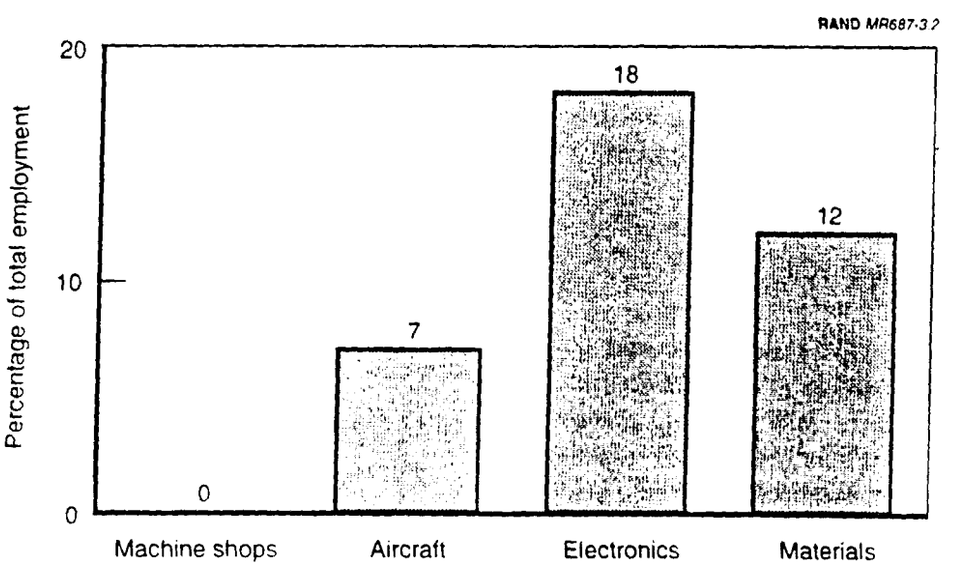


Figure 3.2—Engineers as Percentage of Total Work Force, by Type of Industry, 1994

their workers ("They are like members of my family") and the larger firms, who saw this process as part of the natural business cycle that they had experienced before.

On the other side of the coin, only four firms indicated that the personnel cuts they had to make had required layoffs of some of their better workers or had reduced their comparative advantage in particular product lines.

The majority of firms that laid off workers provided no special transition assistance to them other than the required notice of termination. One-third, all larger firms, however, provided two weeks termination pay; in rare cases termination pay was graduated according to seniority. Two firms extended medical coverage in addition to termination pay and another helped in obtaining unemployment benefits. Finally, a handful of firms helped in the transition, one by hiring a consultant to provide outplacement services, one by providing psychological and financial counseling, and the others by referring laid off employees to state placement programs.

A few of the firms that had laid off personnel were hiring again by the time of the interview, including two of the growth firms that at one point had cut their labor force prior to renewed growth. With a couple of exceptions, these firms made no particular efforts to rehire their laid off workers. By and large, these firms found it relatively easy to find replacements.

## CHANGING PRIME-SUPPLIER RELATIONS

At the same time that suppliers of defense prime contractors were experiencing significant declines in demand for their products, prime contractors were altering the ways in which they conducted business with their suppliers. In response to defense downsizing and increased global competition, and in keeping with changing practices in other industries, prime contractors are implementing business strategies to become more competitive (Velocci, 1994). Most have instituted a certified preferred supplier program in an effort to keep their most capable suppliers as well as to require suppliers to comply with a set of cost-cutting and performance standards as a condition for certification.

Fifteen of the 25 firms in this study had been so certified by 1995. They viewed the changes required under the preferred supplier program as an imposition that served the prime contractors' interests more than their own. At the same time, respondents from both certified and other firms emphasized the special relationship they had with the primes through both personal relations and a high-performance track record, and they viewed the operational changes they had to make as being beneficial in the long term.

## Preferred Supplier Requirements

Prime contractors have instituted a preferred-supplier certification program for supplying firms with which they continue to do business. Our respondents described the program as having three major components:

- just-in-time delivery of products[5]
- supplier responsibility for quality control
- supplier submission to periodic reviews and audit of operations[6]

The just-in-time (JIT) delivery requirement may be the most important way (but not the only one) in which primes have changed their service and part-buying practices. For instance, we obtained the following quotes from various suppliers:

> Primes are bargaining hard with suppliers, offering multiple contracts with no inflation adjustment in the fixed prices.

---

[5]Just-in-time delivery refers to the reduction of the time required between a part being ordered by the prime and the delivery of that part by the supplier, to as short a time period as one week or less. The practice significantly reduces the cost of keeping a large inventory.

[6]Some of the changes in business practices implemented by primes follow changes in practice that have taken place over the past decade or so in other, heretofore more competitive, sectors of U.S. manufacturing. Just-in-time delivery as well as higher performance standards have been a practice widely used in the auto industry for more than a decade. These practices might have eventually been adopted by the defense aerospace industry without defense downsizing. The fact that adoption of these practices coincided with the decline in defense spending suggests that the latter accelerated their adoption.

> Primes are now buying "standardized packages" from distributors with the distributor conducting all necessary acceptance testing and inventorying.
>
> Primes used to finish the products we forged...they forced us to find machine shops and take the responsibility for the finished product. A new term has been coined for this practice: "precision forging."

Although prime contractors may vary in the quality control requirement they have imposed on their suppliers, nearly all require suppliers to use statistical process control (SPC) on all of their machines.[7] Some primes require compatibility with their electronic data interchange (EDI)[8] and compliance with the International Standards Organization (ISO 9000) quality standards and guidelines.[9] According to several respondents, primes are active in monitoring compliance with their quality control guidelines with periodic reviews and audits.

Finally, as part of the certification process, primes review the suppliers' operations and make suggestions for changes that suppliers are expected to implement. Suppliers are required to report to the prime on progress.

## Suppliers Strive to Comply With Requirements

Three out of five firms in our sample reported being certified by one or more prime contractors, proudly exhibiting their plaques in their lobbies (Table 3.4). While many firms described their preferred-supplier status as critical to maintaining demand for their products, a significant minority of firms viewed such formal certification as irrelevant. In addition, several respondents had never heard of the program. Electronics and machine shops executives were disproportionately represented in the latter group.

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[7] SPC is a computerized quality control system that allows an analyst to identify the pattern of errors made and the cause of those errors.

[8] EDI is an electronic system that allows prime contractors and suppliers to exchange blueprints, orders, inventory, and other information.

[9] ISO 9000 is a quality process certification necessary for doing international business. It is not U.S.-government mandated.

Table 3.4

**Preferred-Supplier Status by Type of Firm**

| | Preferred Supplier | |
|---|---|---|
| Type of Firm | Yes | No |
| Machine shops | 3 | 3 |
| Aircraft parts | 7 | 1 |
| Electronics | 3 | 5 |
| Materials and other | 2 | 1 |
| Total | 15 | 10 |

Regardless of how they felt about the preferred-supplier program, suppliers sought to comply with its requirements by installing or accelerating computerization of quality control and other operations of their firms, providing training in the use of SPC to their production workers and others, adding capabilities they did not have before (e.g., computerized testing and dimensional measurement), rendering their computer-aided design (CAD) system compatible with that of the prime, and/or increasing their own inventory of products and/or raw materials to meet JIT requirements. The latter was seen as one of the most important additions to operating costs resulting from the preferred-supplier program.

## Costs and Benefits to Preferred Suppliers

Firms that are preferred suppliers have mixed feelings about the advantages of this status. Most saw it as "a necessary price to pay to stay in business." Beyond that, their impressions of the program ranged from it being legal extortion, to a burden without benefits, to an aid to improving their competitive position.

Respondents complained about a long and varied list of costs and burdens. Some mentioned investing considerable funds to upgrade their computerized systems, providing training to their staff, and buying measuring equipment for quality control with no immediate visible payoff. Others complained that the program was administratively burdensome and time-consuming, adding to labor costs. One firm even hired a full-time administrator to run the program while they pursued ISO 9000 certification. In the words of some of the respondents,

> [The program] adds paperwork; especially in the area of data requirements for new products. We now have to produce 80 different data items where 15 used to be sufficient.
>
> [The program] adds documentation on SPC process which needs to be done anyway to produce quality parts.
>
> Primes have developed themselves into a government bureaucracy.

One firm complained about higher transaction costs of JIT due to constant change in particular orders. Another complained about punitive penalties for delivery delays.

Still, a number of respondents indicated they had benefited from the preferred supplier status. Several indicated that they found the prime's recommendations for operational changes useful and cost saving. In respondents' words,

> [The program] led to reduced set up costs and rework and labor costs savings as a result of the thinking through required by the initiatives.
>
> [The program] led to cut lead times.

Even suppliers who had emphasized the burdens of the program viewed preferred-suppliers requirements as promising potential long-term benefits yet to be realized. This view is best captured in the following two statements:

> However, I think that in the long run increased competition and quality improvements will be worth the costs.
>
> Still the firm is better off for all the hassle...we are more conscious of production planning and accelerated the computerization of our operations.

Overall, we gained the impression that supplying firms' management took the requirements "as a given and necessary step" to continue to do business. Our comparison of the growth pattern between preferred and nonpreferred firms seems to support the view that the first drew little revenue advantage over the 1990–1994 time period. There are proportionately as many firms with growing revenues

among preferred suppliers and nonpreferred suppliers in our sample, and their average rate of growth was similar. However, among firms whose total revenues had declined, preferred suppliers experienced a relatively lower decrease in their revenues than nonpreferred firms—29 percent vs. 52 percent, respectively—suggesting they may have benefited somewhat from their preferred status.

As noted above, few if any of the suppliers we interviewed felt they were in a position to resist the requirements imposed by the primes. However, as some of these suppliers become increasingly successful in the commercial market they may rethink their relationships with defense prime contractors. One respondent whose firm had been among the most successful in making this transition told us his firm was now able to turn the question around: "The question we are now asking is whether this is a preferred **customer**; if not, forget it." He added the following:

> Most competitors have gone out of business, and we are having the upper hand with negotiations with primes. We raised our prices . . . Unlike the southern California suppliers, the primes have not yet had to rethink their markets and reinvent themselves.

Clearly, such a turning of the tables was a unique occurrence among firms in our study. But if the number of suppliers were to continue to decline and effective competition for given products weaken, the nature of the relationship now dominated by the prime might even out or even tip in the other direction.

## Following the Primes' Example

Many of the firms we interviewed indicated thinking about passing through to their own suppliers the same requirements they themselves had to meet to stay in business with the primes. But most were unable to do so because they lack the bargaining strength to do so, particularly at a time when demand for basic material is rising. Thus, they find themselves in the difficult position of being forced to take on additional burdens by the prime contractors, but unable to pass on those burdens to their own suppliers.

Still, a few firms in our sample had acted by the time of our interviews (spring 1995). Six of the 25 firms in our sample cut down

on the number of their suppliers: "We now make more judicious, more focused decisions." A few other firms indicated that their base of suppliers had shrunk and that some prices had gone up as a result. Finally, a handful of firms had sought to pass the JIT, quality control, and lead timing requirements on to their own suppliers, but not always successfully. It appears that the trend was in the direction of passing through the tighter requirements "down the supplying chain." One medium-size aircraft parts supplier implemented its own certified-suppliers program with periodic ratings for each of its suppliers. At the other extreme, a growing medium-sized electronics firm created a formal program to communicate more effectively with its suppliers: "We are treating them more as partners than we used to."

Chapter Four

# ADJUSTING TO DEFENSE DOWNSIZING

The previous chapter discussed differing degrees of success that small aerospace suppliers had in coping with shrinking defense orders and changing production standards. For some firms, diversification was relatively easy. They knew about and had been involved in making products for commercial nonaerospace customers. For other firms inexperienced in the commercial sector other than aerospace or unable to easily transform their products into commercial items, diversification was harder or impossible to achieve.

This chapter explores the various steps that firms took to take advantage of defense downsizing or to blunt its impact and discusses the difficulties they encountered. These steps, which firms took singly or in combination, included

- lowering costs of production
- increasing productivity
- strengthening existing market niche
- developing new products
- being bought by or acquiring another firm or corporation
- increasing exports.

We discuss these elements in greater detail below.

## LOWERING COSTS OF PRODUCTION

As documented in the previous chapter, the primary way of reducing costs of production was to reduce the number of employees. In most cases administrative staff were targeted first and disproportionately relative to production and engineering staff. A few firms seized this opportunity to make deep cuts—up to 50 percent—in overhead and administrative staff that had grown excessively over the years.

A few firms sought to cut costs in other ways as well. First, a handful of firms imposed pay cuts on their employees of 10 percent or so, or imposed a salary freeze. Second, four of the smaller firms—two machine shops and two electronics firms—reduced their facility costs by either subletting some of their space (three firms) or moving into new, less-expensive space. Third, four firms—one machine shop and three electronics firms—sold some machine equipment. Two of these simply sold all or part of their machine shops, keeping only enough machinery for prototype development and otherwise contracting out for machining.

## INCREASING PRODUCTIVITY

Most firms in our sample increased computerization of some of their operations, including accounting, production, testing, and/or quality control operations partially in response to the prompting of prime contractors (see previous chapter). Respondents were divided as to the actual productivity improvements they had gained from this. Many cited major gains while others were still encountering implementation difficulties.

Apart from such changes, about two-thirds of the firms in our sample did not make other major reorganizational or operational changes. This is particularly the case for machine shops and aircraft parts firms. One machine shop respondent indicated that: "Apart from the advent of computer numerical control (CNC) machines . . . our business has not changed technologically in about 20 years."

Also low volumes in machine shops do not lend themselves to obvious productivity enhancements, although two firms indicated they took advantage of the weakened market to upgrade their machinery

by buying machines at "distress sales for a cent to the dollar," thereby increasing productivity.

Aircraft parts suppliers reported having made some productivity gains in the form of lower rates of defective parts that otherwise would have needed to be reworked (four out of eight firms), reduced lead times (two firms), reduced cycle times (two firms), and reduced inventory costs (two firms). But, by and large, they did not reorganize or make structural changes in their manufacturing or assembling processes. Only one firm had reorganized by consolidating its aerospace production in one building and added a capability to centrally download instructions for CNC machines from a single computer to cut overhead. This firm also increased the responsibility of machinists and assembly workers to conduct their own SPC inspections.

Electronics firms appeared to be most aggressive in their pursuit of productivity improvements, possibly reflecting the rapid changes in product requirements in that branch of the industry. One firm reorganized its plant into new layout and cells, mostly for improved quality control. A second firm decentralized its assembly production processes, giving individual workers power to stop the assembly line in case of defects. This firm also purchased powerful personal computers for design work. A third introduced a number of changes including cost controls, streamlining production processes, introducing total quality management (TQM), and providing a lot of training to the staff. The firm's cycle time for new products was cut from an average 26 weeks to 10, and its revenues reportedly increased from $58,000 per employee in 1988 to $102,000 per employee in 1994. This firm is also working toward concurrent engineering, the only firm in our sample that reported moving toward use of this technique to further cut down the cycle time for new products.

We did not collect the information needed to verify claims of increased productivity. We computed changes in total revenues per employee as reported by our respondents as a crude way of assessing combined effects of productivity gains and cost cutting across firms. The results displayed in Table 4.1 support the qualitative information discussed above. Two-thirds of firms in our sample reported increased revenues (in 1994 dollars) per employee, averaging 17 per-

**Table 4.1**

**Gross Revenues per Employee per Type of Firm, 1990 and 1994**

| Type of Firms | Number of Firms | Mean 1990 Dollars per Employee[a] | Mean 1994 Dollars per Employee | Percentage Change |
|---|---|---|---|---|
| Machine shops and aircraft parts | | | | |
| Increase | 7 | 77,000 | 93,000 | +21 |
| Decrease | 6 | 104,000 | 72,000 | -31 |
| Total | 13 | 90,000 | 83,000 | -8 |
| Electronics and materials | | | | |
| Increase | 10 | 88,000 | 102,000 | +16 |
| Decrease | 1 | 96,000 | 79,000 | -18 |
| Total | 11 | 90,000 | 100,000 | +11 |
| Total | | | | |
| Increase | 17 | 84,000 | 98,000 | +17 |
| Decrease | 7 | 103,000 | 73,000 | -29 |
| Total | 24 | 90,000 | 91,000 | +1 |

NOTE: Self-reported figures by our respondents are displayed here to assess the direction of change rather than the absolute values. One firm did not provide information.

[a]In 1994 dollars.

cent between 1990 and 1994. Electronics and materials firms were more likely to report such increases than machine shops and aircraft parts firms. Indeed, among the latter, half of the firms reported a decline of revenues per employee, averaging 31 percent between 1990 and 1994. It is likely that, unless demands from their traditional aerospace customers increase in the near future, these firms will have to make further cost cuts and/or productivity gains in order to maintain profitability. These firms are generating about $72,000 in revenue per employee, short of the $100,000 that several respondents volunteered was needed for profitability. In contrast, the 1994 revenue per employee of electronics and materials firms averaged $100,000, an average 11 percent increase since 1990.

## STRENGTHENING EXISTING MARKET NICHE

Most of our respondents described themselves as having few or no competitors for at least some of their products. In the words of some of these respondents,

> We make big parts that very few can do.
>
> We are the only one who can make the full spectrum of parts from 40 feet long parts to two inches items.
>
> We produce parts at an extremely high level of precision that few can match.
>
> Ours is a unique patented design.
>
> We make products for very severe environments, such as operating in water, acid, or space...[we have] virtually no competition.

Some firms with such competitive advantages worked toward reinforcing that advantage passively, confident that they would survive while their competitors may flounder. Others reinforced that advantage purposively by concentrating on that market and seeking to increase their share of a declining market. For example, some actively pursued preferred-supplier certification from one or more prime contractors; some even bought out a competitor (see "Purchase or Acquisition" below).

Another way that a firm may have sought to maintain a comparative advantage or increase its market share is through vertical integration. Instead of producing parts that the primes would assemble, they now are developing the capabilities to make subassemblies. For instance, one firm specializing in the manufacturing of switches is producing full switchboards, while another manufacturer of transformers and conductors is producing fully assembled, turnkey, mobile power stations.

## DEVELOPING NEW PRODUCTS

Because few new programs are being initiated in defense, only a few of the firms reported having developed new products for the defense

market: a fuel tank, large rings, and a few other products respondents were reluctant to describe. By and large, firms that previously engaged in R & D had refocused their programs toward the development of products for commercial markets.

With respect to the development of new products for nonaerospace commercial business, firms we interviewed can be divided into essentially two groups: (1) machine shops and aircraft parts firms and (2) electronics firms.

Firms in the first group either did not attempt or had great difficulties penetrating the commercial market. The following represent typical comments on this issue:

> Most machines hold such high tolerances that they are too costly for production of commercial tooling. [machine shop]
>
> We hired a marketing sales representative for one year . . . he did not get one contract . . . and we decided that conversion to commercial would not work for our firm. [machine shop]
>
> Our products are strictly high tolerance . . . and we find that there are no applications for them outside of aerospace. [aircraft parts firm]
>
> We have no plans and no capabilities to expand into the commercial market. [aircraft parts firm]
>
> Our big problem is marketing . . . we are amateurs [in the commercial market] and it is expensive [to market]. [aircraft parts firm]
>
> Our products are just too expensive for most commercial applications.

In short, it has proven extremely difficult for specialized aerospace machine shops and parts makers to overcome their lack of knowledge of the commercial market, know-how for a more tolerant market, and the requirements for lower more competitive prices. These hurdles are particularly difficult, if not impossible, to overcome for small firms in which the owner is not only responsible for marketing but also for overseeing operations. For some firms, the obstacles have proven so onerous that they are no longer trying.

This is not to say that a handful of firms in our sample did not have some success in breaking into the nonaerospace market. One machine shop is now producing molds for an automobile part. And two of our eight aircraft parts firms did so as well; they are producing gas turbines for power plants and a new product for telephone applications. In none of these cases have nonaerospace commercial applications become a major portion of the firms' business.

Most of the electronics firms already had some knowledge of the nonaerospace commercial market and were engaged in it. Hence, most such firms in our sample were aggressive and generally successful in pursuing commercial alternatives. One of our respondents characterized this attitude particularly well: "We are always looking for new commercial applications." The new products they developed range from the sophisticated to the less sophisticated technologically and are serving primarily the computer, wireless communications, automobile parts, and recreational equipment markets.

Some of the new commercial products developed or manufactured by firms in our sample included the following:

- clocks for timing synchronization in the cellular and PC markets
- two- and three-dimensional chips for portable communication devices and computers
- devices using radio signals to set clocks automatically and remotely
- diagnostic equipment for automotive test applications
- three-dimensional high-speed cameras for auto industry
- thermal printers
- Net-guard back-up for computers
- motorcycle wheels
- switches for microwave ovens and cellular phones
- medical devices
- boat parts

- drive shafts for race cars
- parts of bicycles and roller blades
- auto pistons

In making choices about the types of products to develop and manufacture, firms generally chose products consistent with their existing equipment and machinery and their staff expertise. They stuck with what they know best. New equipment was purchased in a few cases to complement already available equipment, sometimes purchased at fire sale prices at auctions.[1]

With two exceptions, conversion or expansion to commercial markets did not require staff retraining or hires of new staff with skills not previously available within the firm. In one of the exceptions, a firm hired a power supply designer and had to train workers in soldering. Another firm had to retrain workers to enter the commercial market, particularly their quality inspectors; the emphasis had to be refocused for cost-competitive reasons.

Generally, firms reported making the transition without major difficulties. But one firm that tried to produce new product lines requiring new equipment had quality problems at first, having dropped its military specification quality standards for the commercial products. They solved this problem by going back to using those standards firm-wide.

Aside from having lower tolerance levels for quality, commercial markets were described by our respondents as "requiring more costs discipline," being "more competitive," and having "shorter product cycles."

Aggressive pursuit of commercial alternatives to defense generally paid off. Seven of the nine firms in our sample that included this element in their overall strategy saw their revenues grow over the five-year period considered by our study.

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[1]In one case a firm purchased equipment to prevent an existing or a potential competitor from using it. The firm had no intention to use the equipment itself.

## PURCHASE OR ACQUISITION

A complement or substitute to developing new products for either the defense market or commercial markets was to merge, purchase, or be acquired by another firm or corporation.[2]

### No Mergers

Among the firms we interviewed, none had merged with another firm over the past five years. One machine shop did pursue a merger that eventually was not implemented.

### Purchases

Two firms in our sample—one machine shop and a material-specialized firm—were purchased. The first was acquired by another machine shop. Although it had lost more than half of its revenues since 1990, it had several valuable assets: a customer base of over 400 clients and a reputation of putting the needs of clients ahead of other priorities, including its own expansion. The purchasing firm had state-of-the-art CNC equipment but lacked a large customer base. The resulting combination was a firm that could better serve a broad base of customers. Although the merger was only a few months old at the time of our interview, sales had increased 40 percent over that period and the combined firm had instituted a second shift. Commenting on a new order they had recently secured from a commercial customer, the firm's new owner made the following observation:

> Before the merger, firm A could have handled the order but would not have known about it, while firm B would have known about it but could not have handled it. It's a natural fit. You could go around the rest of your lives and not find a fit as good as this.

The material-specialized firm was purchased by another firm in 1991. At time of purchase, the staff size was cut in half and the firm refocused on what it did best. It diversified within the aerospace

[2] As noted in Chapter Three, only nine of the 424 firms in our original list had merged or were acquired over the period considered in this study.

industry, expanding its forgings of parts for engines, the business of its purchaser.

### Acquisition

Acquisition of another firm was the most frequent means used by the firms in our sample to gain entry into the commercial market or strengthen their commercial products line. It was used by five of the eight electronics firms we interviewed and by one material specialty firm. Machine shops and aircraft parts firms did not resort to this option or were unable to do so. Indeed, respondents of four additional firms (three of which were aircraft parts) indicated they were actively looking for a buy-out to "gain new product lines," "merge with a competitor," "integrate vertically," or "buy a supplier firm." One firm acquired eight smaller firms over the five-year period.

Reasons for acquisition of other firms varied from getting a foothold in a new booming business, to providing services or products complementary to existing product lines, to stopping the hemorrhaging caused by defense downsizing—in one case as much as half of revenues are now generated by the newly acquired firm.

## INCREASING EXPORTS

A handful of the firms in our sample sought to increase sales to foreign markets, including foreign defense and commercial aerospace markets. In these firms, exports ranged from a low six percent to a high 40 percent of sales in 1994. Among exporting firms, electronics firms dominate, but some aircraft parts and a machine shop also increased exports.

## ENABLING FACTORS

Five factors emerged from our interviews as having played a major role in helping individual firms survive or overcome the downsizing:

- **Low debt service.** Nearly all firms in our sample indicated that low debt service had been most instrumental in their still being in business to date. That was particularly the case for small

firms. They owned all equipment, and if they did not own the facilities in which they worked, they leased them.

- **Change in leadership**. This played an important role in a few larger firms. It allowed for decisions to be made, particularly regarding layoffs—which others were reluctant to make.
- **Corporate financial backing**. This enabled the majority, but not all, of the acquisitions discussed above.
- **Anticipation of the downturn**. A handful of respondents indicated that they, or their predecessors, had anticipated the downturn in demand for defense products and had already initiated actions to address it.
- **Management capabilities**. Reliance on one individual for all key management, development, and marketing activities—a typical model of smaller firms—constrained the ability of some firms to look for new business opportunities.

Chapter Five

# DUAL-USE PRODUCTION

At the outset of defense downsizing, Congress and others expected that its effects on the economy and the defense industry might be alleviated by aggressive transfer of defense technology to commercial applications. An increased overlap between defense and commercial production is also seen to be desirable to maintain an adequate industrial defense capacity, improve efficiency in the defense sector, and allow for technological spillovers between the commercial and defense spheres (National Economic Council, 1995; Office of Science and Technology Assessment, 1994).

To encourage an increase in the overlap between defense and commercial production and promote the development of dual-use technology, the Clinton administration provided close to $1 billion per year from 1993 to 1995 for its dual-use technology initiatives. The program defines dual-use as broadly encompassing products, services, standards, processes, and acquisition practices that are capable of meeting requirements for military and nonmilitary applications. It provides funding to overcome perceived barriers to dual-use production, including lack of access to capital, high risks, and onerous federal regulations governing contractual requirements.

In our interviews we asked about each firm's experience with dual-use products and production processes, about their advantages and disadvantages, about use of government programs supporting dual-use, and about changes that DoD might consider in order to make dual-use production more feasible. This chapter discusses our findings regarding the extent of dual-use production, dual-use production processes, and barriers to increasing dual-use production.

Firms' use of governmental programs to encourage dual-use as well as other governmental assistance programs related to defense downsizing are discussed in the next chapter.

## EXTENT AND CHARACTERISTICS OF DUAL-USE PRODUCTION

With regard to dual-use production, firms in our sample fell into one of two groups: (1) they made products for both defense and commercial aerospace or (2) they made products for nonaerospace commercial applications in addition to producing for the defense and commercial aerospace industry (Table 5.1). Although the extent of dual-use production varied significantly among firms, all firms saw the advantages for economies of scale, evening out the business cycles in the two/three markets, and hedging against defense cuts to outweigh the costs. None of the firms interviewed produced exclusively for defense, a finding seemingly in contrast with earlier studies of dual-use, which had focused on the larger prime contractors.[1]

Firms that produce exclusively for aerospace indicated using the same production processes for products manufactured or assembled for aerospace defense or commercial applications. Our respondents

**Table 5.1**

**Differences in Dual-Use Processes by Type of Firm**

| Type of Firm | Number Using Identical Processes | Number Using Significantly Different Processes |
|---|---|---|
| Produce for aerospace market only | 12 | 1 |
| Produce for aerospace and other commercial markets | 10 | 2 |
| Total | 22 | 3 |

[1] For instance, after surveying 206 (primarily large) companies with $60 billion in federal sales, van Opstal (1993) concluded that most companies that operate in both the commercial and federal markets either physically segregate some portion of their operations or set up a separate data management system to do business with the government.

stressed that there were no real differences in the product requirements—precision, testing, and quality control—required by these two markets. They used the same machinery and assembly processes.

Firms in the second group also indicated making no major differences in their production processes for defense and commercial applications (including the auto and sports equipment industries) even though precision and quality control requirements were generally less stringent for commercial applications.[2] In most cases, defense requirements drove their production process. Only one firm in our sample had (recently) separated physically its defense from commercial production lines. This separation was seemingly not instituted because of production incompatibility for its dual-use products; rather, it was instituted as a means to overcome difficulties the firm had had in meeting cost accounting and quality assurance requirements in its defense products. Another two firms had separate stockroom and testing facilities for defense and commercial products.

## ISSUES IN DUAL-USE PRODUCTION

Defense procurement regulations—including accounting requirements, specifications and standards, and other unique contract requirements—are often cited as barriers to dual-use production. Nevertheless, all firms in our sample adjusted their accounting, testing, quality control, and production processes to meet the requirements of the defense and commercial markets with the attitude that it was a given, i.e., part of doing business.

This is not to say that there are no differences (hence, costs) associated with dual-use production. Chief among various differences mentioned by our respondents were the added traceability, more stringent testing requirements, and the 100-percent inspection requirement on shipments for defense, compared with products made for commercial applications. To most respondents this added a sig-

[2]This finding is consistent with Kelley and Watkins (1995), who found that "the vast majority of defense contractors manufacture military products in the same plants with the same workers and equipment employed in producing items for commercial customers" (p. 531).

nificant amount of paperwork, which they have to absorb in their overhead costs. A few respondents indicated that this affected their price competitiveness for commercial products. But no one could provide a reliable estimate of the added costs resulting from these higher traceability and accountability requirements imposed by the federal government. One respondent estimated that defense paperwork takes 50 percent more time to deal with than commercial paperwork. Another estimated that DoD procurement requirements added 50 percent to the cost of a part relative to the cost of the same part produced for a commercial nonaerospace client.

Implementation in many firms of a computerized production planning system, allowing the itemization of each part order, is helping some of the larger firms to ease this problem. A few firms have dealt with it squarely, passing through the added costs to the government. Two firms, one large and one small, have two price lists for the same product, one for defense clients and one for commercial clients. And one small firm directly charges quality assurance, testing, and inspection costs: "There is no problem with dual production as long one has traceability on each product."

Other differences that were noted by our respondents were idiosyncratic to their particular products. One firm indicated that its products for defense applications had to be tested at much higher extremes of temperature than commercial products. Another indicated that defense clients required more daily and weekly interaction than commercial clients. And another medium-sized firm indicated that doing business for defense requires it to keep a more capable engineering department; technicians (instead of engineers) would suffice for commercial applications.

## BARRIERS TO EXPANSION OF DUAL-USE PRODUCTION

All firms in our sample were already engaged in some form of dual-use production prior to defense downsizing. Hence, production processes and government regulations, while the source of frustration and added costs, did not appear to be the prime barrier to expansion and/or development of their products for commercial applications. For these firms, the primary barriers to dual-use expansion lie elsewhere and differ by type of industry.

Firms that produce exclusively for the aerospace industry, albeit both defense and commercial, are primarily machine shops and aircraft parts firms. As noted in the previous chapter, these firms had great difficulties penetrating the commercial market for nonaerospace applications and were largely unsuccessful even when they tried. In addition to having a cost structure and machines that do not lend themselves easily to more competitive and larger-volume applications, they typically lack knowledge of the commercial market and have no commercial marketing experience. Smaller firms have the added handicap of limited access to capital and of having the responsibilities for overseeing day-to-day operations, development, and marketing concentrated in one person, typically the owner.

These difficulties are reflected in the fact that only three out of the 13 machine shops and aircraft shops in our sample were successful in developing a foothold in the nonaerospace commercial market—making molds for automobile parts, gas turbines for power plants, and a new product for telephones.

Electronics and materials firms were more successful in expanding into the nonaerospace commercial markets for one or both of two reasons: (1) They already had experience with the commercial market; (2) demand for their high-tech products was strong. They also typically had a significant engineering development department. By and large, however, these firms stayed with what they knew best and, with one exception, did not make changes in their production processes. And by 1995, all technology transfer had taken place one way, from defense to commercial applications.

Chapter Six

# USE AND EFFECTIVENESS OF GOVERNMENT PROGRAMS

This chapter explores the extent to which federal and other defense conversion programs have helped small defense suppliers cope with the decline in demand for their defense products. It first outlines the range of programs available to assist firms, and then moves to a discussion of defense suppliers' experience with these programs. It concludes with a discussion of what respondents said government could do to help them in the current economic environment.

## DEFENSE CONVERSION PROGRAMS

The administration and Congress implemented a number of programs intended to alleviate the effects of defense procurement cuts on firms, their employees, and the communities in which they are located and to assure the continued maintenance of a responsive, competitive, and innovative defense industry. Programs specifically directed to assist firms are linked to two groups of projects: the Defense Technology Reinvestment Projects (TRP) and Defense Personnel Retraining Projects (DPR).

The TRP seeks to promote the development and application of dual-use technologies in the belief that civil-military integration within the defense industry would help maintain an adequate capacity for defense production if and when needed and also enhance competition. It was first activated in 1993 and received funding of less than $1 billion yearly. A detailed description of the program included in

this initiative is available elsewhere (see Assembly Task Force on Defense Conversion, 1994).

For the purpose of this study, four characteristics of the TRP should be noted. First, nearly all of the programs covered by TRP require setting up a partnership between two or more firms or between a firm and a state or local government entity or university. Only one sizable program—the Dual-Use Technology Initiatives—does not require the formation of a partnership. However, its focus is primarily on electronics, microelectronics, advanced simulation, computing systems, and communications technology, hence favoring firms already established in these areas. A second notable characteristic of some of these programs is a matching requirement of as much as 50 percent. Third, only two programs are directed specifically to businesses with less than 500 employees. One program, the Small Business Innovative Research program was appropriated a modest $145 million in 1994 and is oriented toward "technology innovation and new commercial products which benefit the public." The other, Business Loans–Defense Economic Assistance, provides loans to firms detrimentally affected by the closure or reduction of a DoD installation. Finally, because these programs were not implemented until late 1993 and early 1994, they had been available for only a short period by the time of our study.

The Defense Personnel Retraining Projects (administered primarily by the Department of Labor) provide resources to employers (as well as state and local grantees and representatives of employees) for retraining and readjustment assistance to workers dislocated by defense cutbacks. Funding for these programs did not exceed $200 million per year. These programs do not have a matching requirement and all firms are eligible. These programs have also been in operation for a short period of time.

In addition, there are a number of other existing federal, state, and local assistance programs designed to assist employers in various areas of marketing, training, and/or product development, and to assist employees in retraining or job placement. In our interviews with firms, we sought specific information on use of and experience with not only the federal defense conversion programs but with all other programs as well.

## USE OF AND ATTITUDES TOWARD GOVERNMENT PROGRAMS

Two-thirds of the firms in our sample had not used a government program of any kind during the five-year period covered by our study. Our respondents' general attitude toward government programs was plainly negative, if not hostile. There are also practical reasons firms did not make use of available governmental assistance. Time and resources were significant constraints for most, especially for smaller firms. It is time consuming to find out about available programs and at least five of the respondents in smaller firms simply did not know about the availability of such programs. For those who did know, they could not take the time and/or did not have the know-how or resources (working capital) to meet the application requirements. The following were typical responses:

> [We] looked at a lot of programs, but declined to participate because of the large amount of hassle and paperwork involved. [a 50-employee machine shop firm]

> In addition to the paperwork, it is difficult for small firms to work out the teaming arrangements required [by the program]. [a 70-employee electronics firm]

> We submitted one proposal to the Technology Reinvestment Program . . . it was onerous in time and teaming requirements. In the end it was too costly and filled with delays. [a 300-employee electronic firm]

> We looked into the Small Business Incentive Research Program with one of the National Labs . . . but most institutions going for this are universities. They are geared into meeting the paper requirement . . . we could not compete. [a 10-employee electronic firm]

> They don't make it easy...It took eleven months and three submissions [before being approved].

> It only makes sense to invest the time and energy in these programs if they actually are useful in your current operations. You can't make any money with the project per se.

In brief, nearly all firms aware of the programs noted that the transaction costs of the programs simply outweighed any perceived benefits, especially for small firms. Small firms do not have the know-how and often cannot afford the time and/or resources needed to meet all the documentation and, in some cases, teaming requirements of the various programs. Larger firms, by contrast, generally have human resources or engineering staff whose job it is to be knowledgeable about such programs. As one respondent stated, "... it would be difficult to do it without a human resource specialist on our staff."

Our findings discussed in previous chapters regarding the difficulties firms encountered breaking into new markets and in making dual-use products suggest also that one reason for low use of these programs may lie in their design and focus in the first place. As noted above, few programs are specifically targeting small firms, which do not have the know-how or resources to compete with larger firms. Also, the difficulties encountered by some firms had less to do with questions of technological development or product design than with lack of experience in marketing, lack of knowledge of the commercial business environment, and lack of resources to acquire those. No federal defense conversion programs address these issues. Finally, machine shops and aircraft parts makers face a unique problem in the sense that their know-how and manufacturing technology are not geared to making the types of products that are in growing demand in the civil economy. For these firms, conversion or diversification beyond the commercial and defense aerospace industry may require not only a sizable new investment, but also changing their manufacturing structure and the type of products they make. Current programs are not geared to undertake such a fundamental firm restructuring. Whether they should is a question that cannot be addressed here.

## EXPERIENCE WITH ASSISTANCE PROGRAMS

Most firms had no experience with federal government assistance programs. But one in four firms benefited from a nonfederal assistance program, California's Employment Training Panel (ETP). The ETP is a job development agency making grants to firms to assist in training and retraining workers. The primary use of the ETP program by our respondents was for training and retraining of their staff in

Total Quality Management (TQM), SPC, computer utilization, reading blueprints, and some math. The subsidized training was carried out on-site and/or at a state university or community college. All firms indicated it was a positive experience and that they had benefited from the training. The following are sample comments:

> It gave [our firm] a headstart in TQM vis à vis competitors.

> It has been such a great thing within the company, firms should do it even without government money.

Firms generally seemed quite willing to subsidize or pay for training if it directly helped workers on the job. Although training usually took the form of on-the-job training, some firms also offered formal certification programs or English classes. High-technology, highly specialized firms indicated that it may take years to train new employees before they bring in more revenues than they cost the firm.

A handful of firms also took advantage of the California Employment Development Department's (EDD's) workshare program, which allows employees to keep working part-time at the firm while drawing a prorated share of unemployment compensation.

Only one electronics firm successfully submitted a proposal to TRP. In recounting their experience, the firm's executives stressed that the documentation and teaming requirements (they teamed up with a university) eventually proved to be too costly and filled with delays. They eventually continued the development of their program with the firm's own funds. They said, ". . . if a product will make it in the commercial market, then firms will develop it anyway."

Finally, one small employee aircraft parts firm received a Small Business Association loan under the Small Business Innovation Research program. Otherwise, several of our respondents singled out SBA for being unresponsive to their needs. These firms indicated that they were strapped for working capital and that SBA was not geared to meet this need.

## SUGGESTIONS FOR CHANGES

Our respondents had no suggestions about making changes to existing programs or implementing new programs. This was consistent with their general perception that any benefits were outweighed by the costs of application and meeting specific program requirements. Their suggestions generally sought to address two areas that were perceived to affect their operations negatively: (1) governmental regulations and (2) the uncertainty and volatility of the defense market.

Nearly all of our respondents called for a reduction in governmental regulations including those of the Americans with Disabilities Act, Occupational Safety and Health Administration, and Environmental Protection Administration. A sample comment was, "They cause delays and add to costs of doing business."

A few respondents also saw a need to reform and rationalize the government acquisition process, making pragmatic suggestions ranging from the general (adopting commercial practices for non-aerospace or aerospace work) to the specific (choosing one standard from among the various currently used systems).

Uncertainty and volatility in the defense market was a cause of concern to a handful of our respondents. They had experienced last-minute cancellation of projects after they already had incurred costs to begin production of parts. Suggestions to address this problem ranged from adopting a two- or three-year budgeting cycle to developing a long-term acquisition strategy. One firm was considering leaving the defense market altogether for this reason.

Finally, a few respondents from mostly small firms advocated the development of apprenticeship programs and subsidized education in basic and advanced manufacturing products.

Chapter Seven

# A LOOK AT THE FUTURE

This chapter examines our respondents' expectations for their respective firms' future and discusses the firms' capacities to significantly increase defense production should a national emergency require it. It concludes with an assessment of the potential for a diminished defense supplier base in southern California.

## GUARDED OPTIMISM

To the question of whether the firm had any specific plans to expand its operations over the next five years, more than three out of five firms answered yes and only one out of five answered a definite no.

All eight firms that grew over the past five years (see Chapter Three) expected to continue to grow over the next five. And so did half of the firms whose revenues have declined over the past five years. The perception among these firms is that the worst is over and/or that the prospect for growing demand for their products is bright. An executive of a medium-sized aircraft parts firm enumerated four reasons for his optimism:

- Competition is decreasing: "Other firms are buying work now; they cannot do that for long before they go bust."
- Airlines are starting to order spare parts. This will be reinforced by the need to buy special parts for quieter aircraft to meet noise-control requirements.

- A large proportion of the aircraft fleet will have to be replaced in coming years because of obsolescence. New planes are cheaper to fly.
- The industry has high barriers to entry: "No one will give you any work of substance without a track record. Also, you need the capital equipment and the good will [of the primes]."

Others were more focused on the bright prospects for their own products, most of which were at the edge of technology, such as three-dimensional data analysis products, or had moved into new expanding markets through acquisitions or mergers. For some firms, however, availability of working capital was seen as a potential constraint to their expansion plans, particularly among small firms.

As noted above, five firms in our sample had no expectations for expansion in the next five years. These firms saw their revenues being halved, on the average, over the past five years. Two are small machine shops with less than 10 employees currently, and three are aircraft parts firms, two of which are small ( seven and 38 employees, respectively). These are also the only two firms in our sample that indicated they were planning to lay off additional staff. The larger of the two held back laying off staff in the face of declining revenues, declaring that "we have been carrying deadwood . . . but this is a family company you know." The second smaller firm had orders for only two more weeks of operations at the time of the interview and was considering closing down altogether.

The overall optimism of our respondents about the prospects for their respective firms may depend as much on factors outside of their control as on their own actions. Two factors are likely to be important for the future of firms such as those in our sample. The first concerns the future level of demand for defense procurements. A further decline in that demand would place several firms in jeopardy of collapse, particularly among machine shops and aircraft parts firms whose continuing dependence on defense aerospace is high. Electronics and materials firms are less vulnerable to further declines in defense procurement. But whether they can continue their expansion and diversification into commercial markets will depend on continued aggregate economic growth.

## EMERGENCY RESPONSE CAPABILITIES

We asked all of our respondents the following hypothetical question: Should a national emergency require it, would you be able to resume your defense-related production at your previous peak level within a short period of time?

Two out of three of our respondents answered that they would be able to do so within four to six months (Table 7.1). One potential bottleneck mentioned by a handful of firms concerned raw materials. These firms reported the following obstacles to raw-materials acquisition: (1) many suppliers had left the business, (2) suppliers face higher costs for resin and semiconductors, (3) lead time needed for various metals is 12 weeks, and (4) titanium depends on producers in Russia, Australia, and China. Hiring of qualified labor was not seen as a major bottleneck in this context.[1]

Most of those who answered in the negative did so because they were already working at or near capacity—even though all but two had downsized in the past five years—and did not contemplate reducing their commercial production to augment their defense-related production. This was particularly the case for the electronics firms. The one material-based firm and the aircraft parts firm that answered in the negative were considering leaving the defense market altogether or closing down operations, respectively.

**Table 7.1**

**Capabilities to Increase Defense-Related Production by Type of Firm**

| | Would Be Able to Increase Within Four to Six Months | |
|---|---|---|
| Type of Firm | Yes | No |
| Machine shop | 3 | 3 |
| Aircraft parts | 6 | 3 |
| Electronics | 4 | 2 |
| Materials and other | 3 | 1 |
| Total | 16 | 9 |

[1] Although individuals may not perceive difficulties in hiring qualified staff in the event of a renewed build-up, such difficulties might develop should all firms require significant hiring of new staff.

Three out of the six machine shops in our sample indicated they would have difficulties gearing up rapidly (within six months) to expand production to their previous peak level. Their reasons varied: One had lost key personnel not easily replaced; another's CNC machines were operating at 93-percent capacity, and there would be long delays in obtaining raw materials such as skins for wings; another expected delays with hiring qualified staff and finding new suppliers to replace the lost ones.

## STRENGTHS OF SOUTHERN CALIFORNIA DEFENSE SUPPLIER BASE

A key strength of the southern California defense supplying industry is that it has a high concentration of both its customers and its own suppliers located right in this region. As expected, the relative importance of being located close to customers or suppliers varied among the firms in our sample. As shown in Table 7.2, machine shops were evenly divided among those who thought proximity to customers, suppliers, or both was most important; electronics firms generally favored being close to their suppliers or are footloose, as are the materials-specialized firms; and the aircraft parts firms favor a location closer to their suppliers.[2]

**Table 7.2**

**Location Preferences by Type of Firm**

| | Location Preferences | | | |
|---|---|---|---|---|
| Type of Firms | Close to Customers | Close to Suppliers | Close to Both Customers and Suppliers | Footloose |
| Machine shops | 2 | 2 | 2 | 0 |
| Aircraft parts | 3 | 5 | 0 | 1 |
| Electronics | 1 | 3 | 1 | 2 |
| Materials and others | 1 | | | 2 |
| Total | 7 | 10 | 3 | 5 |

[2]Those who value proximity to customers more highly generally do so because of their need for face-to-face interactions often among engineers or other staff of the firm and the customers. Those who value proximity to suppliers value it because they want to minimize their transaction and shipping costs and speed delivery times.

Certainly, several respondents said that California is an expensive place to do business, citing stringent environmental regulations, workers' compensation, high rental and housing costs, and high taxes. Executives of these firms constantly receive promotional material from other states and have considered moving. Nonetheless, the overwhelming majority of firms said they had no short-term plans to relocate either within or outside the region, typically because moving costs would be too high. There were only two exceptions. One small firm is considering relocating somewhere in southern California to lower facility rental costs. The other firm, a medium-sized employee aircraft parts company, is considering relocating either to Arizona, Colorado, or North Carolina to lower labor and tax costs. However, the estimated $1 million plus costs of moving the equipment alone will be a major constraint to implementing such a move.

Another strength of the defense supplier industry in southern California is its ready access to a varied and skilled labor force. Most respondents indicated experiencing no problems hiring workers with the skills they need. There were two exceptions. Machine shop respondents (as well as a few others) complained about difficulties finding skilled machinists. Reportedly, trade school graduates have solid programming skills but inadequate problem-solving and machining skills, i.e., the ability to cut, rough, and sand parts properly. A few firms also reported difficulties hiring qualified software engineers, particularly for the development of electronic warfare systems, or engineers with hands-on design and testing experience.

With the exception of machine shops, most of the firms had a sizable proportion of foreign-born employees in their labor force—ranging from 14 to 75 percent. Most of these immigrants are production workers, although they were also on the engineering staff of some firms. Not one firm indicated having experienced major problems in managing a diverse labor force. The only problem mentioned concerned language, and several firms were offering English classes to overcome communication problems.

In short, we saw little evidence that southern California was losing its relative strengths in its "concentration economies" for the segment of the defense supplier industry that was the focus of our study. A diverse and competitive number of firms remain in operation. Al-

though nearly all had experienced a decline in defense revenues, many were able to partially or fully compensate with revenues from other sources. All indicated they had few difficulties hiring the staff they needed and most had the capacity to increase defense production fairly rapidly, should the need arise.

Chapter Eight

# DISCUSSION AND POLICY IMPLICATIONS

All firms in our study were affected by the rapid decline in defense procurements that has taken place since 1990. In this chapter, we summarize the experiences that the firms we studied had with conversion to the commercial market, possible loss of future critical defense capabilities, the effectiveness of dual-use policies, and government programs relating to conversion.

## CONVERSION TO THE COMMERCIAL MARKETS

Defense downsizing had a profound initial effect on all small suppliers in this study. Overall, they lost more than 40 percent of their defense revenues (in constant dollars) and some firms lost more than three-fourths of their defense revenues. In addition, they had to comply with new, costly requirements—including JIT delivery, increased responsibilities for quality control, and frequent auditing—imposed upon them by prime contractors. Compliance with these requirements was typically seen as a price of continuing to do defense business.

To date, these firms have been able to absorb these shocks. Nearly all of the firms that held contracts with three of the largest military aircraft programs in 1990 were still in business in 1995. And our case studies of 25 firms indicate that most of these firms were partially or fully successful in replacing the lost defense revenues with revenues from other, mainly commercial, sources. As a group they recovered about two-thirds of lost defense revenues.

Success in compensating for lost defense revenues varied significantly among firms, with the main differentiation occurring along product lines. Machine shops and aircraft parts firms were least successful in compensating for lost defense revenues, replacing only about 20 percent of lost revenues *mostly through increased revenues from the commercial aerospace industry.* Their manufacturing processes—designed for narrow tolerances and low volumes—are not readily transferable for high-volume, low-cost-competitive, nonaerospace commercial applications. In addition, they have neither the knowledge nor the marketing capacities to enter nonaerospace commercial markets. As a result, few have been able to make the transition, and most had abandoned trying to do so, perceiving it as simply not feasible.

In contrast, electronics and materials firms were generally more successful. They not only compensated for lost defense revenues, but a majority of those firms actually increased significantly their revenues from other sources, mostly nonaerospace commercial applications. These firms already had a foothold in the commercial market prior to 1990 and were facing a growing market for the types of products they manufacture.

## EFFECTS ON DEFENSE CAPABILITIES

Although many firms had to downsize and otherwise make changes in their operations to accommodate the requirements from prime contractors, most did so in ways that did not weaken capabilities and in some cases even increased them. Most firms with an engineering staff generally protected that staff from downsizing altogether or made cuts that were less than proportionate. They also cut costs and increased productivity—although in some cases only at the behest of the primes—and otherwise accelerated the computerization of parts of their operations, particularly their accounting and quality control processes. Here again, electronics and materials firms were seemingly more aggressive in doing so than machine shops and aircraft parts providers.

As a result, by early spring 1995 most of our respondents were guardedly optimistic about the future of their firms, with most expecting to grow in coming years. Some, however, based their optimism on an assessment that the decline of defense procurements had bottomed

out and/or that their competitors had been weakened. Also, most indicated that they had no plans to move away from southern California, which offered both ready access to customers and suppliers and a skilled labor force. Generally, firms reported facing few difficulties hiring staff with the needed skills. Finally, most firms indicated they would be able to increase production to their previous peak levels within four to six months, should the need arise.

Nevertheless, some findings from our case studies raise a number of issues that may be the harbingers of difficulties to come and which deserve further research attention. First, machine shops and aircraft parts suppliers remain almost entirely dependent on the aerospace industry. Further reduction in military aircraft programs and/or reduction in demand from commercial aerospace may push many such firms out of business. To date, these firms have downsized significantly, have low profitability, and face an uncertain demand that does not allow them to plan or make significant investments to increase productivity or develop new products. This is particularly the case for small machine shops that rely on the skills and expertise of one person, typically the owner. And, as noted above, most do not see aggressive conversion to commercial applications as a feasible alternative.

Second, the products that were developed for commercial markets by our firms are not at the technological edge. Apart from some electronic applications, expansion into commercial markets that has taken place to date occurred primarily in the recreation, automotive, and health industries. And, whenever any transfer of technology has taken place, it has occurred from the defense to the civilian sector.

So far, availability of the skills needed by supplying firms was not seen as a problem. But there were two notable exceptions: qualified machinists and engineers with special skills. The first were seen as a "dying" breed, being replaced by people inadequately trained in problem solving and machining skills as opposed to machine programming skills. Special skills reportedly in short supply included software programming for electronic warfare systems and hands-on design and testing experience. We were unable to make an independent assessment as to whether such difficulties posed a major problem for the future or whether firms were mainly concerned about the

sometimes intensive on-the-job training required to reach proficiency.

Finally, some of the executives whose firms were most successful in expanding into commercial nonaerospace markets were growing increasingly frustrated with the difficulties and current volatility of doing business with defense prime contractors. Successful expansion and/or conversion to commercial markets may incite some firms—mostly electronics and materials—to cease production for the defense market altogether. Although only one such firm was seriously considering doing so in the near future, in the long term successful conversion to commercial markets might also translate into a narrower base of suppliers supporting national defense.

## DUAL-USE PRODUCTION

Federal policy has encouraged dual-use production as a way to get firms to lessen their dependence on defense contracts and to lower production costs when they produce items for defense customers.

All the firms in our study group were making products for defense and commercial markets before defense outlays began to drop in 1990. However, some firms were more successful than others in serving both sets of customers.

Machine shops and aircraft parts makers, for example, concentrated on serving the aerospace industry exclusively. They marketed to defense and commercial customers in that industry, and they used the same production lines and processes for products they sold to each: both sides of their production used the same strict quality controls and tolerance levels.

Electronics and materials firms, in contrast, delivered products to nonaerospace customers in addition to defense and commercial aerospace customers. They, too, did not distinguish between defense and nondefense production processes, even though the testing and tolerance levels required by their customers differed significantly between the two.

Without doubt, dual-use production involved additional hassles and costs for the firms in our study, namely, added paperwork and new traceability and quality control requirements. But all the firms ac-

cepted these as costs of doing business and had not estimated what these costs actually amounted to.

For most firms in our study, the barriers to expansion of dual-use production and technology do not lie with the production requirements or with the costs associated with dual-use production. Rather, what appears more important are the range of commercial opportunities for products a firm manufactures and how comfortable or experienced a firm is marketing to commercial customers. As explained above, these barriers have been more severe for machine shops and aircraft firms than electronics and materials firms. In addition, for machine shops and aircraft firms, commercial applications are difficult to develop because their manufacturing processes don't lend themselves readily to nonaerospace production.

## EFFECTIVENESS OF DEFENSE CONVERSION PROGRAMS

With one exception, our small firms indicated they had not used any federal government program over the past five years. One-fourth of the firms had received funds from California's Employment Training Panel to train or retrain their workers in total quality management, SPC, computer utilization, reading blueprints, and math. Those who had used that program had a positive experience and indicated training helped both their workers and the firm. Many of the smaller firms did not know about the various programs or that they were eligible for them.

For those who had considered applying for one or another of the federal conversion programs, including the Technology Reinvestment Projects (TRP), all felt that the transaction costs of the programs—filling out the applications, meeting all of its requirements, and the approval delays involved—outweighed any benefits. By and large, the smaller the firm, the more serious was this barrier to usage of governmental programs. Small firms do not have staff with the necessary experience, nor do they have other resources to compete with larger firms.

The structure and the focus of the programs also may not be designed for the needs and capabilities of suppliers as opposed to prime contractors. Forming the partnership required by some TRP programs is difficult or infeasible for the supplying firms we inter-

viewed. If a partnership is not required, the focus is limited to products (electronics and computerization) that leave out machine shops and aircraft firms. The latter need to invest in marketing, acquire knowledge of commercial markets, and adjust their manufacturing processes in order to access commercial markets. But there are no defense conversion programs to address these issues.

It remains to be seen whether a program redesign to address the issues raised would be any more effective for firms such as those interviewed for this study. Our respondents implied a negative answer to this question. They had no suggestions for adjusting or implementing new programs to cope with the overall economic changes they are facing. Indeed, our respondents' general attitude was plainly hostile toward government programs. Rather, they focused less on specific programmatic issues than on the broader macro issues affecting their specific firms. The majority called for reduction in governmental regulations, including worker's compensation, environmental regulations, and defense procurement practices. For the latter, suggestions for changes included adopting commercial practices for nonaerospace and aerospace work, and selecting one quality standard among the many now in use. Several respondents called for reducing the uncertainties and volatility of defense procurements by adopting a two- or three-year budget cycle and/or developing long-term acquisition strategies.

Appendix

# DEFENSE SUPPLIERS INTERVIEW

The RAND Corporation, with support from the Department of Defense, is examining the effects of military downsizing on California's economy and how it might affect a variety of firms such as yours. We want to present as complete and balanced picture of how downsizing has affected firms supplying products and services to defense prime contractors, so the information you give us is very important. Anything you tell us will be held strictly confidential; we will not identify either individual respondents or firms in any of our reports or briefings to DoD. Our findings will be available to policymakers as well as to the public.

In our interview, I would like to ask you about **how defense downsizing has affected** your firm and employees and **what measures** you have taken if any to address problems and/or opportunities that it has created for you. First however, I would like to ask some general questions about **your job and the firm:**

SECTION I

1. a. Could you briefly describe your responsibilities and how long you have held your current position?

_____

_____

b. How long have you been with the firm? _____

2. a. Could you briefly describe what the **FIRM produces**?

| PRODUCT | DEFENSE | COMMERCIAL | BOTH |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

3. a. When was the firm established? _____

b. More than one location? Y N

c. Was it established initially to serve the **commercial or defense** market?

When did you begin working on: _____Defense? _____ Commercial?

Why did you add defense or commercial?

_____

_____

d. How many defense prime contractors do you currently do business with?

_____

Where are they located? How important is it to be located near your customers or suppliers?

_____

_____

SECTION II

Now, I would like to ask you about the **level of your activities and employment**, and how they have changed over the last five years.

4. First, I have some questions about sales volume
   - what were total sales last year?
   - how does that compare with 5 years ago? (%)
   - what % of sales last year to defense?
   - 5 years ago?
   - At peak of sales to defense suppliers?

| TOTAL **SALES** | | DEFENSE SHARE % | | |
|---|---|---|---|---|
| LAST YEAR | VS. 5 YEARS AGO | LAST YEAR | 5 YEARS AGO | @ PEAK |
| | | | | |
| | | | | |

5. a. How many **full and part time employees** do you currently employ (number or shares)?
**FILL IN TABLE**

b. distribution by type of job?
c do you employ any foreign-born workers?
d distribution by type of job?

| | Engineers, Sci. | Production workers | Administrative | Total |
|---|---|---|---|---|
| NOW | | | | |
| 1990 | | | | |
| | | | | |
| Current Workers: | | | | |
| U.S.-born | | | | |
| Foreign-born | | | | |

e. Which countries do your foreign workers primarily originate from?

---

Has the management of a mixed native- and foreign-born labor force presented any special problems for your firm?

---

f How did the employment change occur over the past 5 years?

All at once? _____ what year?_____
In waves? _____
Steadily over time? _____

What factors accounted for the change(s) ?

---

---

IF DECREASE-ASK QUESTIONS 5g TO 5i, IF INCREASE-SKIP TO QUESTION 5j

g. What percent of the employment loss came from:

- lay offs? _____
- early retirement ? _____
- attrition? _____

-- did this differ across major occupations? Y N

- scientists and engineers _____
- production workers _____
- administrative _____
- others _____

h When you had to layoff employees did you help them in any way in their transition ? Y N

PROBES: (Please be specific about any YES responses)

YES NO

____ ____ o Gave them termination pay

____ ____ o Hired consultant/firm to provide counseling and /or assist in job search

____ ____ o Referred workers to a federal or state program.

If yes, which ones?

_____

____ ____ o Others

i. What do you think was most helpful in assisting your laid-off employees find new jobs?

j. Have you ever experienced **problems in recruiting** the labor you need? Y N
If yes, what kind of skills have you experienced difficulties with?

_____

_____

k. Do you have any training, remedial education, or other programs for your workers? Y N

Which programs?

_____

_____

Are they targeted to specific skills or groups of workers? Y N (Specify)

_____

_____

SECTION III

We would now like to focus on the effects of defense downsizing more specifically

6 a. In what **other ways has your firm's operations** been **affected in a negative way** by defense downsizing?

PROBES: (Please be specific about any YES responses)

YES NO

___ ___ o Has moved to another smaller facility ?

If yes, where were they located before?

And why did they stay in the area?

___ ___ o Has sublet some of the firm's facility space ?

___ ___ o Lost some of your best employees

___ ___ o Cut administrative costs; reorganized

___ ___ o Sold or disposed of equipment Which equipment?

___ ___ o Lost comparative advantage for some products ...Which ones? Why? To whom?

___ ___ o Other

Now, we would like to explore **active measures** you might have taken to minimize the effects of defense downsizing on your firm's operations. Has the FIRM.

7. a become a **"preferred" or "strategic"** supplier to one or more of its prime contractors Y N

If no, why not?

IF YES:
With which prime defense contractors? _____

What advantages did you gain?

PROBES o Assured minimum demand Y N

o Gave a competitive advantage over your competitors Y N
(Specify)

Were any changes required to be made in the operations of the firm? Y N

If so, what were they? _____

_____

_____

_____

b (Has the FIRM) **changed the way it outsources** or deals with its own suppliers? Y N

IF YES, HOW?

PROBES

o Cut the number of their own suppliers Y N

o Passed along any changes required by the prime contractor Y N

c. (Has the firm) made any **changes in its manufacturing operations** in the last 5 years ? Y N

IF YES

What % of operations have changed ? ____

Was existing equipment reorganized into new layouts or was new equipment purchased? Y N

What was the cost of these changes? _____

Which **areas** were the changes made in?

PROBES: (Please be specific about any YES responses)

YES NO

___ ___ o machining

___ ___ o inventory (Just-In-Time system?)

___ ___ o material handling

___ ___ o assembly

___ ___ o finishing

How have these changes **improved** your operations or made them more **flexible** ?

PROBES (Please be specific about any YES responses)

YES NO

___ ___ o reduced cycle times

___ ___ o reduced inventory costs

___ ___ o less rework necessary (use Statistical Process Control?)

___ ___ o lower labor costs

d. (Has the firm) expanded into **new products for the defense market** ?

If yes, What products? Why these pro

Did you have to retrain your workers for the new defense production? Y N

If yes, what retraining was necessary? Y N

Was new equipment purchased? Y N

IF YES, What kind? What

IF NO, was any retooling of existing equipment necessary? Y N

Were new management or accounting systems necessary ? Y N

If yes, please describe.

(In expanding into new defense products) did you encounter any s

e. (Has the firm) expanded into **new products for the commercial market**?

If yes, What products? Why these proc

Did you have to retrain your workers for the new commercial production? Y

If yes, what retraining was necessary?

Was new equipment purchased? Y N

IF YES, What kind? What

IF NO, was any retooling of existing equipment necessary? Y N

Were new management or accounting systems necessary ? Y N

If yes, please describe.

(In expanding into new commercial products) did you encounter a
problems? Y N

If yes, please describe.

_____

_____

f. (Has the FIRM) taken **any other measures** we have not yet mentioned ? Y N

IF YES: Please describe; be specific.

PROBES

o Merged with other firm Y N

o Acquired other firm Y N

o Licensed the firm's technology to others Y N

Now we would like to ask about your FIRM's experience with **dual-use products** or with producing defense and commercial goods with the same employees or equipment

IF NO DUAL USE PRODUCTS OR PRODUCTION INDICATED IN QUESTION 2.A, SKIP TO QUESTIONS 8.B AND 8.D

8. a What **assets are used** in both defense and commercial production?

PROBES: CHECK ITEMS MENTIONED

Y N

___ ___ o plant or warehouse space

___ ___ o personnel What occupations?

_____

___ ___ o management/accounting systems

___ ___ o equipment Which?

CAD/CAM Y N
Computerized machine tools Y N
Flexible manufacturing system Y N

___ ___ o Other

b What are the obstacles to, or **disadvantages** of, dual-use production?

PROBES: (CHECK ITEMS MENTIONED)

Y N

___ ___ o incompatible accounting requirements

___ ___ o overhead (costs, allocation rules)

___ ___ o oversight requirements

___ ___ o stringent military specifications

___ ___ o concerns about technical data rights

___ ___ o Other

___

___

___

c What are the **advantages** of dual-use production?

PROBES: (CHECK ITEMS MENTIONED)

Y N

___ ___ o economies of scale (spread overhead, unused capacity, etc.)

___ ___ o leverage existing technical knowledge

___ ___ o diversification as hedge against further defense cuts

___ ___ o better access to (newer?) commercial technologies

___ ___ o better cost discipline from competition with commercial firms

___ ___ o Other

___

___

d What **changes** must DoD make in order to make dual-use production more feasible?

___

___

___

___

9 a In making any of the adjustments induced by defense downsizing we have just

discussed , have you been assisted by or used any **government programs** for firms hurt by defense cuts? Y N

If no, why not?

If yes, please describe: *(fill in grid below)*

- which program
- type of assistance ($s vs in kind)
- effectiveness of assistance? If yes, why?
- suggestions for improvements to that program

o Technology Reinvestment Program | **Y N | $ in-kind** | _____

_____

_____

o Employment Training Panel | **Y N | $ in-kind** | _____

_____

_____

o California Trade & Commerce Agency | **Y N | $ in-kind** | _____

_____

_____

o Bureau of Export Administration **Y N | $ in-kind** | _____

_____

_____

o Small Business Administration **Y N | $ in-kind** | _____

_____

_____

b. Do you think the government could (should) have provided other forms of assistance to firms such as yours? Y N

If yes, what kind?

SECTION IV

Now, we would like to ask you a few questions about how you perceive the **future for your firm**.

10. a. Does your FIRM has any specific **plans to expand** its operations over the next five years? Y N

If plans to **expand**, please describe how you plan to do so

PROBES: CHECK ALL ITEMS THAT APPLY

Y N

___ ___ o Selling current products to new markets If yes, which ones?

_____

_____

___ ___ o Developing new products If yes, which ones?

_____

_____

___ ___ o Buying another firm

___ ___ o Merging with another firm

b. Does the FIRM has specific **plans to reduce** its staff within the next few years ? Y N

IF YES

Why? _____

_____

What products would be affected ? _____

_____

_____

Which group of workers would be most affected? _____

_____

_____

C. Do you anticipate the firm might have to close down ? Y N

If **yes**, why? _____

_____

_____

c. Does the FIRM has any firm **plans to relocate** within the next five years? Y N

If so, why? _____

_____

what location are you considering? Why?_____

_____

_____

_____

Still thinking about the future, we would like to ask you the following **hypothetical question:**

d. Should a national emergency require it, would you be able to resume your defense related production at your previous peak level within a short period of time? Y N

IF NOT, WHY NOT?

PROBES: CHECK ITEMS THAT APPLY

Y N

___ ___ o Lost skills needed

Specify: _____

_____

___ ___ o Specialized equipment

Specify___ _____

_____

___ ___ o Lost qualified suppliers For which products?

___ ___ o Delays in recruiting and training staff

How long would it take your firm to get back to previous peak defense

production level ? _____

e. What should government do to maintain the ability of the country's defense suppliers like you to meet the technological and volume demands in the event of a national emergency ?

_____

_____

_____

_____

FINALLY, DO YOU HAVE ANY COMMENTS ON THE STUDY, THE SURVEY, OR ANYTHING ELSE?_____

_____

_____

_____

Thank you

**FURTHER IDEAS FOR REORGANIZING** :

CHOP 10.A THROUGH 10.C. ASK THESE (IF AT ALL) IN CONTEXT OF QUESTIONS ABOUT CURRENT SITUATION (i.e., #5, #6).

# REFERENCES


Assembly Task Force on Defense Conversion, *Defense Conversion Resource Guide*, third edition, Sacramento, Calif.: Assembly Publications Office, July 1994.

Dardia, Michael, *Is Small Beautiful? Firm Size and Job Losses in the Aerospace Industrial Base*, Santa Monica, Calif.: RAND, Dissertation RGSD-117, 1995.

Defense Conversion Commission, *Adjusting to the Drawdown*, Washington, D.C., December 1992.

Dun and Bradstreet Information Services, *Business Information Report*, Parsippany, N.Y., 1995.

Ernst & Young, *International Aerospace & Defense Research Study*, New York, 1993.

Flaming, Danial, and Nack Drayse, *Technology and Jobs: Defense Conversion in the Los Angeles Region*, Los Angeles: Economic Roundtable, 1994.

Gentsch, Eric L., and Donna J.S. Peterson, *A Method for Industrial Base Analysis: An Aerospace Case Study*, Bethseda, Maryland: Logistics Management Institute, DC201RD3, January 1993.

Kelley, Maryellen R., and Todd A. Watkins, "In from the Cold: Prospects for Conversion of the Defense Industrial Base," *Science*, Vol. 268, April 28, 1995, pp. 525–532.

National Economic Council–National Security Council, Office of Science and Technology Policy, *Second to None: Preserving America's Military Advantage Through Dual-Use Technology*, February 1995.

Office of Technology Assessment, *Assessing the Potential for Civil-Military Integration: Technologies, Processes, and Practices*, Washington, D.C.: U.S. Government Printing Office, OTA-ISS-611, September 1994.

Tyson, K. W, J. R. Nelson, N. I. Om, and P. R. Palmer, *Acquiring Major Systems: Cost and Schedule Trends and Acquisition Initiative Effectiveness*, Alexandria, Va.: Institute of Defense Analysis, 1989.

U.S. Bureau of the Census, *Statistical Abstract of the United States: 1992*, 112th edition, Washington, D.C., 1992.

U.S. Bureau of the Census, *Statistical Abstract of the United States: 1994*, 114th edition, Washington, D.C., 1994.

van Opstal, Debra, *Integrating Civilian and Military Technologies: An Industry Survey*, Washington, D.C.: The Center for Strategic and International Studies, ISBN 0-89206-223-3, April 1993.

Velocci, Anthony L., Jr., "U.S. Shakeout Tests Suppliers' Flexibility," *Aviation Week & Space Technology*, February 14, 1994, pp. 48–51.